The Australian Journal of Science

VOL. XI, No. 1 AUGUST, 1948

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THE AUSTRALIAN NATIONAL RESEARCH COUNCIL
Science House
157 Gloucester Street
SYDNEY

PRICE ONE SHILLING

Registered at the General Post Office, Sydney, for transmission by post as a periodical.

The Australian Journal of Science

VOL. XI, No. 2 OCTOBER, 1948

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Science House
157 Gloucester Street
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Registered at the General Post Office, Sydney, for transmission by post as a periodical.

The Australian Journal of Science

VOL. XI, No. 3 DECEMBER, 1948

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Science House
157 Gloucester Street
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PRICE ONE SHILLING

Registered at the General Post Office, Sydney, for transmission by post as a periodical.

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Science House
157 Gloucester Street
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PRICE ONE SHILLING

Registered at the General Post Office, Sydney, for transmission by post as a periodical

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VOL. XI, No. 5 21 APRIL, 1949

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THE AUSTRALIAN NATIONAL RESEARCH COUNCIL
Science House
157 Gloucester Street
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PRICE ONE SHILLING

Registered at the General Post Office, Sydney, for transmission by post as a periodical.

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VOL. XI August, 1948 No. 1

An Experiment in Journalism

WITH this issue, THE AUSTRALIAN JOURNAL OF SCIENCE enters into the second decade of its existence. In January, 1937, the General Council of the Australian and New Zealand Association for the Advancement of Science resolved that one of the functions of the Australian National Research Council should be the publication of a scientific journal. For some years there had been discussion on the need for a periodical of general scientific interest which would not compete with existing journals published by scientific societies and institutions. It was felt that there should be a publication "in which short summaries of research may appear in advance of the full reports; in which summaries of current work may be available to the general scientific reader; where book reviews may appear, and current news, and personal information; where proceedings of scientific societies and the doings of Universities, Museums and National Laboratories may be chronicled; and where correspondence on matters of importance to science may be published". Thus were set out, in our first issue, some of the ideas which would provide justification for an addition to the scientific journals then published in Australia.

The first editorial article stated that "an experiment in journalism is to be regarded just as would any other scientific experiment: practical trial alone will supply ultimate justification or otherwise".

An editorial committee was appointed under the chairmanship of Dr. A. B. Walkom to devise content, form and title for the periodical and to arrange for its publication. The committee approached scientists in all States and in New Zealand to act as representatives in collecting articles and news and in furthering the interests of the periodical. The first issue, with the title of THE AUSTRALIAN JOURNAL OF SCIENCE, appeared in August, 1938, and publication has continued since that date through ten volumes. In view of subsequent events, and having in mind the measure of success achieved by the JOURNAL, it may be considered fortunate that the decision to publish was made at that time and was carried into effect promptly. Had there been a delay of a year or so it may well be that this JOURNAL would not yet have appeared.

The task of the editorial committee of a new journal of this type is no easy one in normal times, but the outbreak of war in 1939 added greatly to the burden, which was subsequently made heavier by shortages in paper and difficulties in the printing trade. Thanks to the generous cooperation of scientific workers in Australia and New Zealand, the critical early years were successfully negotiated and it may now be said, after the first ten years of publication, that the JOURNAL has made secure its place in scientific literature.

The scientific workers, of course, have provided the material for publication, but there are other aspects of cooperation which are just as essential. For continued publication it was necessary to have financial assistance, which was forthcoming from time to time in the form of donations from several commercial firms, from the Australian and New Zealand Association for the Advancement of Science, from the Royal Society of New South Wales, and from the Rural Bank of New South Wales. Such donations have amounted to over £1,500 and have, together with proceeds from advertisements generously inserted while circulation was still limited, supplemented the subsidies which the Australian National Research Council has been able to provide from its limited sources of supply—its capitation fees from the Australian and New Zealand Association for the Advancement of Science and grants from the Australian Commonwealth Government.

Further, it must not be forgotten that the JOURNAL has been published through the voluntary work of members of the editorial committee, and in particular through the personal effort and interest of the successive honorary editors—Dr. A. B. Walkom, Dr. H. R. Carne, and Dr. J. L. Still. The achievements of the JOURNAL are the combined result of the ready cooperation of all concerned—in planning, financing, publishing and in providing written material.

So far the JOURNAL has been issued at two-monthly intervals. Expansion of scientific activity in Australia and New Zealand, development in the standard of scientific work, increased consciousness of a scientific community and progress in the reputation of the JOURNAL have all added to the volume of flow of articles, letters, news and reviews coming to the Editor, who has now the desirable embarrassment of a "waiting list" for publication. The change to issue on a monthly basis is delayed only by the need to provide finance and editorial staff. Such a course would be another step towards making available a medium for the prompt publication of results of researches in Australia and New Zealand, and for the communication, with little delay, of other information of scientific interest to "the larger and rapidly growing circle of men and women keenly interested in the general results of scientific study".

The *Australian Science Abstracts*, previously published separately, have, since its inception, been incorporated in the JOURNAL as supplements. These *Abstracts* have now been published for twenty-six years and have proved of inestimable value to Australian scientific workers. They have in turn been edited by Dr. A. B. Walkom, Dr. G. A. Waterhouse, the late T. Hodge-Smith, Dr. H. L. Jensen, and Dr. N. H. White. The honorary abstractors of the various subjects have rendered an invaluable service to their fellow scientists in Australia and elsewhere.

In looking back over our ten years of publication we feel that the aims of the Editorial Committee expressed in the first issue have been substantially achieved. Their expressed policy—"that the columns of the Journal should be open to any information that may be of general interest to its readers"—is one which has contributed, and will continue to contribute, to the success of the venture. The high standard of material and writing and the hopes for future expansion should stimulate and interest the scientific community of Australia and New Zealand. It may fairly be claimed that the "experiment in journalism" initiated in 1938 has been scientifically justified by results.

UNESCO Programme

THE programme of UNESCO is itself a research project immense in scale and scope. It may contain nothing spectacularly novel in concept: the novelty is in giving the reality of application, in a necessarily vast laboratory, to concepts formerly hypothetical. UNESCO is a planned experiment with the world as its crucible and with all peoples sifted in as reagents. It is promoting and exploring reactions, not only between different peoples, but between different minds—artists, engineers, educators, administrators, philosophers, writers, scientists. It is yet far too early to give any report of experimental results, but the manner of approach and the realism of execution have indeed been such as to give to the scientist a confidence in his faith that the solution of the world's immediate and urgent problem lies not at the political level but at the cultural. The scientist who has tended to become sceptical of the lay world after continued frustrations in his own scientific projects may well be doubtful that any medium yet established will really effect an approved scientific approach to the world problems of human welfare. In such case he would be well advised to explore the facts of UNESCO'S undertakings, whereby he may conclude that here is a chance, well worth his deliberate support and earnest effort, that his imagination, judgment, courage and participating work may bear fruit.

UNESCO is taking over the assets, and certain continuing projects, of the International Institute of Intellectual Cooperation established by the League of Nations. Compared with its forerunner, it has a greater sense of realism and increased resources. It has the task of integrating various aspects of education, science and general culture without

destroying the benefits of specialization or of division of labour; of integrating the needs and powers of different nations without losing those peculiar qualities which each nation may contribute to the evolution of science and culture, or the spontaneity of enthusiasm which is nourished by local independence. It is relieved of certain fields by other specialized agencies of the United Nations, such as the World Health Organization, the Food and Agriculture Organization and the International Labour Organization. It acts as a catalyser not only upon various governmental and semi-governmental agencies, but upon over one hundred non-governmental international organizations—such as the International Council of Scientific Unions, the International Council of Museums, the International Federation of Library Associations and the International Federation of Documentation. The immediate resources of UNESCO, in comparison with its project, are so small, both in money and in personnel, that to a large extent it has perforce planned and placed its actions in such a way as to produce an effect of detonation—setting into effect existing powers and organizations over which it has itself no authority, so as to produce a self-generated spread of chain or multiplier type.

Programme has been formulated largely from suggestions put forward by the delegates to the two annual congresses in 1946 and 1947. The first impulse of these delegates, long conscious of lack of fulfilment of their individual creative powers, was to advance all of their pet projects in the hope that here at last was the heaven-sent sponsor. Experience of the Executive in 1947, however, led to pruning and direction of future programme so that each of its components should be directed very clearly to the central purpose of the Organization. "It has become clear that UNESCO'S role is to identify pressing needs, to define ways of meeting them, to bring them to the attention of the proper agencies and to stimulate action upon them." "UNESCO is not a world university or a world research centre: the purpose is to promote collaboration among the nations."

The various lines of action which are being undertaken by UNESCO may be grouped largely into four progressive stages:

1. The emergency need for reconstruction in devastated countries.
2. The need for raising standards of education.
3. The opening of channels and tapping of reservoirs for the free flow of ideas between different phases of culture and especially between differing national cultures.
4. The goal of the enlightenment of human understanding, both as between nations and more generally as to the manner in which man is affected by his environment, by his history and by the forces which he himself has aroused through development in science, technology and general culture.

UNESCO has embarked upon a long-range programme of teaching the illiterates of the world—who number more than one-half of its population—beginning with pilot projects in Haiti, China, British East Africa and the Amazon. Simultaneously it is campaigning for a basic minimum of education for all peoples. It is also proceeding towards the furtherance of education specifically designed to promote international understanding. Among measures taken to further the free flow of ideas are many designed to facilitate the interchange of persons, the use of media for mass communication, the rationalization of publication and abstracting, and the provision of translations. UNESCO has established Field Science Co-operation Offices in certain less-advanced countries; it is seeking to promote a World Register of scientists and it serves as a World Centre of Scientific Liaison. It has approached the United Nations to take urgent and specific action for adequate planning in the basic field of cartographic science. It allocates a large proportion of its budget as grants to the independent International Scientific Unions. It is working with the United Nations for the establishment of international scientific laboratories and observatories. It has itself established stations for high-altitude research and it is initiating a great project of research into various aspects of the Hylean Amazon. In the direction of popular science UNESCO is giving much attention to the popular understanding of social implications of science. These are a few of the items of the current programme of UNESCO.

RECONSTRUCTION.

Although it was not at first intended that reconstruction in the devastated countries should be a deliberate part of UNESCO'S programme, it has been found necessary to put this need at the forefront of all other activities. Thousands of scientists are still without the simplest equipment or materials; their laboratories are empty or broken; their libraries have gone. To make even basic replacements would take a hundred times the money and shipping that UNESCO can procure. Links have been made with other organizations interested in reconstruotion, especially with the International Children's Emergency Fund, which made substantial funds available. UNESCO has itself provided a special secretariat known as the *Temporary International Council for Educational Reconstruction*, or TICER. Through various agencies, including direct field surveys, UNESCO has collected, analysed and coordinated information on reconstructional needs as reviewed by regional committees. In 1947 this survey was directed chiefly to European countries: in 1948 it has been extended to Asiatic and Pacific countries. Complementary enquiries were made from potential donor countries, but experience proved that distinction between countries as *donor* and *recipient* is unreal. Devastated countries are often able to make vital and substantial contributions to particular needs of all other countries—such is the emergency state of the world.

The Anglo-American mission to Europe in 1946 put the scientific requirements of Europe alone at between 60,000,000 and 80,000,000 dollars. UNESCO was able to allocate only 150,000 dollars for reconstruction in its 1947 budget; it allocated 175,000 dollars for purchase of equipment in its 1948 budget and 215,000 dollars for other reconstruction services. The policy to be followed was determined by a desire to give aid on as wide a geographical basis as possible and to give it immediately, as well as being determined by the world scarcities of sources of supply. From war surplus stores the most practicable materials for the purpose were found to be small machine tools, hand tools and raw materials of workshop and laboratory. Their distribution to scientific institutions has enabled students to be trained in technical handicrafts and has enabled the construction and improvization of equipment for scientific teaching and research. Limitations of war surplus stores, however, made it necessary to add new equipment, as regards motorized lathes, drilling machines, grinders and certain hand tools and laboratory materials. Fifty units were made up and were distributed as follows: China, 12; Poland, 9; Czechoslovakia, 8; Greece, 7; Philippines, 5; reserve, 9.

Following experience with such provisional procedure, in which choice and implementation were the sole responsibility of UNESCO, a *Science Credits Scheme* is now being prepared for operation. By this scheme the Committee for Cultural Reconstruction of UNESCO decides apportionment of funds between the recipient countries; the responsible Minister in each country is then asked to determine apportionment between those scientific institutions in his country which he testifies as being in most need of such assistance. The lists so secured are supplied to a joint committee representing the scientific industries of the United Kingdom, the United States of America, France, Sweden and Switzerland, and of other countries which may have exportable material. Each institution, having been supplied with catalogues through the Scientific Apparatus Information Bureau of UNESCSO, then proceeds itself into direct negotiation with manufacturers until it eventually decides what and where to order. The individual institution thus has free choice of type, detail, source and delivery of equipment, within the limit of credit allowed and of supply available.

Replenishment of laboratory material is of course only one of the phases of reconstruction which is within the scope of UNESCO. Attention has been given to problems of primary school teaching in the devastated areas. Thanks to a cash donation from the Greek Government, pamphlets offering suggested solutions for practical problems in teaching have been widely distributed. A special handbook, which has been prepared to aid science teachers, outlines methods for making use of the limited materials and equipment that are expected to be available in even the most completely devastated regions.

Gifts in kind have been received from institutions such as the Geological Survey Library of South Africa, the Encyclopaedia Britannica

and the French Government. The various scientific bodies in Australia which have been holding books and periodicals of all countries to help in the re-stocking of destroyed libraries will find that UNESCO is able to organize their proper distribution.

UNESCO seeks to stimulate and sponsor voluntary appeals and efforts by individuals and independent local bodies to provide supply for reconstruction. A monthly *Reconstruction News Bulletin* has been issued since January, 1947. Campaign materials available include leaflets, recordings of radio broadcasts, and posters. Lecture tours, in conjunction with kindred organizations, have been undertaken in the United States, Canada and Britain.

(*To be continued.*)

The Relation between Teaching and Research in the Universities

DR. F. M. BURNET, F.R.S.*

AT the present time in Australia, and to a large extent elsewhere, appointments to university chairs in the natural sciences are usually made predominantly on the research records of the candidates. The appointee therefore frequently lacks experience in teaching and almost always has had no training in teaching methods or in administration. There is a widely current attitude that the only activity of a professor which matters is his research work: teaching and administration are time-wasting obstacles which are necessary but unfortunate concomitants of the appointment.

This seems to be a highly unhealthy condition, which, like most things human, does not work out quite so badly as it ought to. It is a rather naïve and socially untenable attitude to assume that part-time research, which, because it *is* part-time, must in most instances be of relatively unimportant character, is to be regarded as of greater importance than effective teaching. Good education, with which must be included proper selection of those fitted to benefit by it, is the most important requirement for the production of medical men and scientists. The effective organization of a university department, so that it can fulfil all its functions of teaching, research and outside advice, is a full-time job that is more important than any but the rarest of advances in research.

This may seem a highly heretical statement worthy only of those who regard a university simply as a school for higher vocational training, but as one who can hardly be accused of ignorance about the value of fundamental research, I feel strongly that it should be seriously considered by anyone concerned with attempts to remedy the present difficulties of Australian universities.

The following is an outline of what in my view would be the ideal structure of a university department in one of the sciences, say microbiology. The Head of the department would have final responsibility for all its activities but would spend no significant proportion of his time on personal bench investigations. The professor's primary interest would be in effective teaching, using this in the broadest sense, and in the organization of his department to provide this more and more efficiently. His activities at the research level would be essentially research into teaching methods, the devising of visual aids, improvement in laboratory training, the assessing of capacity for specialized work in students: in other words, educational research applied to the teaching of microbiology.

Within the department would be one or two senior research workers, one at least, of associate or full professorial status, under the professor administratively but with complete independence in their choice of and approach to their research problems and often supported by extra-university funds. Each of these will have his *unit* of collaborators and trainees working under his direction. Lecturing and demonstrating by the research staff would be limited to subjects immediately relevant to their own speciality.

Directly associated with the professor would be a small group of lecturers and demonstrators chosen for their ability and interest in teaching methods. Two should be engaged with the professor in an experimental study of teaching methods in microbiology, probably in association with the university departments of education or psychology.

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From the senior students of high ability passing through the department, aptitude studies should be capable of detecting those ;ely to succeed as teachers or as investi- ,tors. The post-graduate training of the young potential research worker would be begun by attaching him to one of the research units of the department. His subsequent course would follow the same general lines as at present. What is more vital to the present discussion is the training of the man with an interest in teaching to fit him eventually for a Chair of Microbiology.

A certain period of direct laboratory research in microbiology would be essential for anyone who will later have administrative control of research, but it need not go beyond the Ph.D. level. It would be hoped that there would be available, in the university department of education, discussion courses on the methods of higher education in science and in the use of auxiliary methods. These could probably be taken during the period of his bench research. When this is completed he will become a lecturing member of the staff and under the guidance of the professor will undertake the improvement of some aspect of the department's teaching programme and will, if possible, provide objective demonstration that his changes are actually improvements.

Such an attitude to the training of suitably selected graduates would ensure the probability that there would be the same small steady output of potential professors as of potential research men.

It would be completely wrong to suppose that the development of such a structure in a science department would represent a denial of the importance of research in the university. It is designed to strengthen, not to weaken, the research side. No man fit for appointment to a chair would fail to appreciate that active technical research is a vital part of higher education, but it is neither necessary nor desirable that he should himself handle test-tubes and chick embryos. In fact he may well have a broader interest and understanding of research if he is not immersed in the necessarily complex detail of an experimental investigation. He would regularly preside over Saturday-morning discussions of current research in his department and see to it that any promising recruit found his opportunity in some appropriate research unit.

The advantages of the proposals I have outlined are:

(1) Their adoption would revive the self-respect of the man who is a more successful teacher and administrator than an investigator.

(2) They would greatly improve the efficiency of teaching.

(3) They would provide an opportunity for the introduction of *units* of research into departments without the present likelihood of ill-feeling being developed by such action. In this way real research within the universities becomes more likely.

There are two main disadvantages that will need serious consideration:

(1) The current feeling amongst scientists that research has higher prestige than teaching is not going to disappear at a stroke of the pen. Most present holders of chairs were appointed mainly on their research records and it would be both unfair and impracticable to expect them to lay aside their own research activities. What can be asked is that they should foster the ambitions of any young graduate of quality attracted toward educational research and a teaching career. The policy outlined can only come into being by the appointment of men to future vacancies who are in enthusiastic agreement with its principles. Once a successful department was established along these lines it would almost inevitably provide many future occupants of Australian chairs in its particular subject.

(2) The problem must not be shirked of the position of the full-time research worker over forty years of age who has passed his productive period and who cannot under the new policy look forward to a senior teaching appointment. The most difficult problem of any research organization or, for that matter, of any form of high-level human activity is how to deal with the older man who is "clogging the works" before he retires at 60 or 65. The only tolerable solution is to retain him and to hope that, by appropriate stimulation, socially worthwhile use of his techniques and experience can be made. For most young men research activity should be limited to a few years in their period of training and only a strictly limited number should be advised

to adopt it as a permanent career. Training in scientific method by two or three years' experience of research should be regarded in most cases as essentially a preparation for a career of direct social usefulness in medicine, industry, teaching, or technical administration.

Stratigraphical Nomenclature in Australia

DR. M. F. GLAESSNER,[a] DR. H. G. RAGGATT,[b] DR. C. TEICHERT,[c] DR. D. E. THOMAS.[d]

THE question of stratigraphical nomenclature was considered by a Research Committee set up for the purpose under Section C of A.N.Z.A.A.S. at its Adelaide meeting in 1946. The Committee consisted of Professor W. N. Benson, Dr. W. R. Browne, Professor S. W. Carey, Dr. R. W. Fairbridge, Dr. N. H. Fisher, Dr. Dorothy Hill, Dr. F. A. Singleton, Mr. R. C. Sprigg, Dr. C. Teichert, Dr. J. Marwick, Dr. F. W. Whitehouse, with Dr. M. F. Glaessner as Secretary, but many Australian geologists other than committee members took part in discussion and correspondence with the Secretary on the subject.

The report of this Committee was presented to the Perth meeting of the A.N.Z.A.A.S. in August, 1947, and during the subsequent discussion it became apparent that there was general agreement among the geologists present as to the necessity for a code of stratigraphical nomenclature. It was clear also that there was not only a growing recognition of the necessity for definition and more precise use of *time* and *time-rock* terms, but that the time had arrived for adoption in Australia of a classification of *rock* units based in general on the principles enunciated in similar codes in the U.S.A. and Canada. As a result, a resolution was passed at the Perth meeting and approved by the General Council of A.N.Z.A.A.S. that a Standing Committee on Stratigraphical Nomenclature be set up (see this JOURNAL, *10*, 1948, 104).

As it is unlikely that the Standing Committee will be convened prior to the meeting of the A.N.Z.A.A.S. in Hobart in January, 1949, we felt that it was desirable to publish the results of discussions on the subject in order to produce a basis for the work of the new Committee, to bring the matter to the attention of wider circles of Australian geologists, and to invite them to express, in publications or in correspondence, their views on the problem of stratigraphical nomenclature. This step is being taken quite unofficially and without any intention of influencing or prejudicing the work of the Standing Committee. Our sole objective has been to help in speeding up consideration of a matter which it is generally felt is of some urgency at the present moment.

Our proposals concerning *time* and *time-rock* terms do no more than attempt to give, as concisely as possible, definitions of terms which are in common use in Australia, but often loosely used. Our proposals for names of *rock* units follow closely the codes now in use in the U.S.A. and Canada, although some deviations from these codes were found desirable in drafting a code applicable to Australian conditions. It is important to note that the original exposition of the American code (see *reference* (*1*) below) has been followed by proposals for a revision (*reference* (*2*) below) which are closer to European usage.

The principles of the new code have found wide acceptance by individual geologists, companies and official institutions. However, it is apparent from correspondence and discussions which have taken place following private circulation of an earlier draft code that there are many who find difficulty in distinguishing clearly between *rock* and *time-rock* units. In particular, the terms "Series", though correctly defined in standard texts as a major subdivision of a "System", is used both in that sense and as a *rock*-term describing almost any thick sequence irrespective of consideration of the time interval during which the rocks were deposited.

We recommend that all those interested in this subject should study the available literature on stratigraphical nomenclature. Reference is made particularly to the following publications, which contain extensive bibliographies:

(1) Geological Society of America, Bulletin, vol. 44 (April, 1933), pp. 423-459 (reprinted in Bulletin of the American Association of Petroleum Geologists, vol. 17, No. 7, July, 1933, pp. 843-868).

(2) American Association of Petroleum Geologists, Bulletin, vol. 31, No. 3, March, 1947, pp. 519-528.

Copies of these articles may be obtained from the Chief Gologist, Bureau of Mineral Resources, Geology and Geophysics, Canberra, A.C.T.

Australian Code of Stratigraphical Nomenclature

I. INTRODUCTION.

1. In order to cover the practical needs of the stratigrapher in subdividing, classifying and naming stratigraphical sequences, three categories of stratigraphical terms are required: time terms, time-rock terms, and rock terms.

2. Time terms refer to divisions of geological time. All time terms taken together should, therefore, cover the whole of geological time.

[a] Australasian Petroleum Company.
[b] Bureau of Mineral Resources, Geology and Geophysics, Department of Supply and Development.
[c] Geology Department, University of Melbourne.
[d] Geological Survey, Department of Mines, Victoria.

3. Time-rock terms are applied to the sum total of sedimentary and extrusive igneous rocks, irrespective of their lithology, formed during a period of time covered by the corresponding time term.

4. Rock terms are required to designate stratigraphical units of a certain lithological uniformity which are easily recognizable as such in the field. They are defined and named with no special reference to their time of deposition.

II. Time Units and Time-Rock Units.

1. *Era* is the term customarily used for major subdivisions of geological time, e.g., Proterozoic Era, Palaeozoic Era, Mesozoic Era, etc. There is no generally accepted corresponding time-rock term. The term Group was once favoured, but is not used now in this sense.

2. *Period* is the term applied to a major subdivision of an Era. The rocks deposited during a Period are called a *System*, e.g., Cambrian Period, Cambrian System. Period and System terms should preferably be of world-wide application, although this may not be possible in the case of the Pre-Cambrian (e.g., Nullagine Period and System).

3. *Epoch* is the term applied to a major subdivision of a Period. The rocks accumulated during an Epoch are known as *Series*, e.g., Lower Devonian Epoch and Series.

Epoch and Series terms should also preferably be of world-wide application, but terms of intracontinental validity may be used where correlation on a wider basis is difficult or impracticable, e.g., Yilgarn Epoch and Series.

4. *Age* is the term applied to a major subdivision of an Epoch. The rocks deposited during an Age are called a *Stage*. In theory, Age and Stage, being respectively time and time-rock terms, identified on the basis of their fossil content or of that of the overlying and underlying beds, should be of world-wide applicability. In practice it is often impossible to correlate the rocks which have been deposited during such a comparatively short time in different parts of the world. In such cases it may be necessary to set up local time scales in terms of local sequences for the finer subdivisions of geological time, independent of the scales recognized elsewhere, e.g., Janjukian Age and Stage. Age and Stage terms established for local or intracontinental use should be abandoned as soon as definite correlation with one of the international units has been established beyond doubt.

5. No standard terms for time divisions below the rank of Age are recommended.

6. The term *Substage* is recommended for a subdivision of a Stage. The same considerations apply here as set out above for the use of the term Stage.

7. The term *Zone* should be used in a time-rock sense for a subordinate unit not exceeding the magnitude of a Stage containing rocks deposited during the time of existence of a particular faunal or floral assemblage. Zones are named after a characteristic genus or species, the name of the fossil being followed by the word Zone (e.g., *Nemagraptus gracilis* Zone).

8. *Naming of Time and Time-Rock Units.*—The names of time and time-rock units are identical. Most names of Eras, Periods and Epochs are well defined and well known. Some names of Epochs and Series are derived from the names of the Periods and Systems of which they form part (e.g., Lower Devonian Epoch and Series); but in general they should be based on geographical names. The names of Series, Stages and Substages may be formed either by attaching the suffix -ian or -an to a geographical name (e.g., Janjukian) or by using the geographical name with the appropriate unit term (e.g., Burindi Series).

III. Rock Units.

1. The fundamental rock unit to be used in classifying, describing and mapping stratigraphical sequences is the sedimentary formation which is a lithological unit produced by essentially continuous sedimentation. It is proposed that the following criteria, mainly modelled on suggestions developed by the Geological Survey of Canada in 1942, be observed in the description and definition of a formation:

(*a*) *It must contain no apparent evidence of an appreciable break in deposition.* The presence of one or more beds or groups of beds of volcanic origin within a sedimentary sequence is not evidence of an interruption of continuous sedimentation if other supporting evidence is lacking. Interruptions due to contemporaneous erosion are not evidence of appreciable breaks in deposition. Palaeontology may, in some instances, afford the sole evidence of an appreciable break in the process of continuous sedimentation.

(*b*) *In its simplest form it consists dominantly of one kind of rock* as, e.g., conglomerate, sandstone, limestone, etc., or, in some instances, of a variety of one of these rock types distinguished by some special feature or features. *But it may include different kinds of rock* where these individually are too thin, lenticular, or variable in composition to be themselves ordinarily selected as formations. Commonly, where a sedimentary formation contains beds of different kinds of rocks, some or all of these alternate in a regular or irregular fashion.

(*c*) *Recognition of the same formation in different areas is justified when its essential lithological definition is applicable.* Naturally, some variation in lithology is permissible, but a formation must continue to be definable in terms of the dominant kind or kinds of rocks that compose it in its type section or area (see paragraph 2). If, for example, a limestone formation is proved to interdigitate with or grade into shale, the latter must be regarded

as representing another formation, but the boundaries between it and the limestone may have to be chosen arbitrarily.

(*d*) *The upper or lower contacts of a sedimentary formation may transgress laterally horizons of neighbouring formations.* Where this occurs, and so long as the lithological identity of the formation is maintained the formation continues to bear its original name, as long as it is practicable to recognize it as an independent unit.

(*e*) *The top and bottom of a sedimentary formation are defined either by a change in lithology or by evidence of an appreciable interval of non-deposition.* In a gradational sequence the passage beds from one formation to another may be sufficiently distinctive and extensive to be considered as separate, intervening formations.

(*f*) *A formation may hold one or more faunas or floras.* Lithology, not palaeontology, defines the vertical limits of formations except as indicated in (*a*) above.

(*g*) *A sedimentary formation may include minor developments of volcanic rocks,* provided these cannot be recognized as marking an appreciable interval in the process of sedimentation, and provided they are not regarded as integral parts of the formation.

(*h*) *Pyroclastic materials*, whether deposited in water or on land, are to be regarded as volcanic sediments and, hence, may be recognized as sedimentary formations.

2. *Igneous* and *metamorphic* rocks should be classified and named according to the same principles as sedimentary rocks as far as stratigraphical methods can be applied to their study. The petrological character of such a rock will provide the basis for its definition as a formation, e.g., Flinders Basalt.

3. (*a*) As far as possible the name of a formation shall consist of a geographical name coupled with a lithological term which is descriptive of the rock, as is already widely done in Australia. Examples: Gingin Chalk; Wianamatta Shale; Brighton Limestone; Bunya Phyllite.

(*b*) The term *Formation* should be used as part of the name only where the lithological character of the beds cannot be properly described by one lithological term. Such units have in the past in Australia been variously referred to as beds, series, group or stage.

(*c*) The rule to name formations after localities may be relaxed, but only when absolutely necessary, in areas where insufficient geographical names are available. It is suggested that in such cases either fossil names or else rock characters other than lithology may be applied.

(*d*) To assemblages of volcanic rock consisting of lavas and pyroclastic rocks of different kinds the term *volcanics* in conjunction with a geographical name may be applied, e.g., Mt. Devlin Volcanics.

(*e*) Where a large mass is composed mainly of diverse rocks including igneous or metamorphic rocks or both, or is characterized by very complex structures, the term *Complex* may be used.

(*f*) Each new formation that receives a formal name must be explicitly defined at the time of its proposal, though this rule shall not be construed as invalidating well-established names. The definition must cite the geographic feature from which the name is taken. It must also cite a specific locality at which the unit is typically developed, and should include a statement of the important facts that led to the discrimination of the formation and a statement of the characteristics by which it may be identified.

(*g*) Subsurface units shall be given formal names only where names are necessary for adequate presentation of the geological history of the region.

4. In case of synonymy the rule of priority should apply, that is, if it is found that two authors have given different names to the same rock unit, the name chosen by the earlier author should be the valid one. Application of this rule should, however, be restricted to cases where no reasonable doubt as to the identity of the opinion of the authors exist and where the two names have actually been defined on the basis of field observations.

5. A Formation name shall not necessarily be invalid if it is found that it has previously been used for another rock unit of different age in another part of the country. The use of identical Formation names for rock units of different age is, however, to be avoided.

6. The term *Group* may be applied to a sequence of two or more Formations. Rules for the naming of Groups shall be the same as those for Formations, except that in all cases Group names should be geographical names. Where an assemblage of unsubdivided strata is designated a group, the possibility of its later division into formations is implied.

7. A formation may be subdivided into lithologically distinct *Members*, *Lenses*, or *Tongues*, according to the lateral extent of the subdivisions. No special rules shall apply to the naming of such subdivisions, which will usually be of purely local significance.

8. The term *Beds* shall be retained as a general term for stratigraphical units or complex sequences which have not been well defined and are incompletely known as to their thickness and detailed lithological succession. In the naming of Beds the same rules shall apply as for Formations. As far as possible the original name shall be preserved if further investigations lead to a better definition of the sequence as Group, Formation, or any other unit.

Note: In harmony with prevailing practice in British countries, both parts of the names of time, time-rock, and rock units shall begin with capital letters.

Science in the Netherlands Indies during and after the War

R. IJZERMAN.*

POLITICAL DEVELOPMENTS DURING AND AFTER THE WAR.

IN May, 1940, the Germans invaded the Netherlands, thus breaking the connection between the Archipelago and the Mother Country. Immediately after the attack on Pearl Harbour the Netherlands Indies declared war against Japan. In March, 1942, the Japanese invaded Java. The prisoners of war and a part of the population were interned, with terrible results.

After the capitulation of Japan considerable areas of Java and Sumatra remained without control. National feeling ran high, resulting in riots. To deal with these disturbances the Allied troops restored order in the principal cities and their surroundings, whereby the protected areas became sharply defined.

Towards the end of November, 1946, Dutch troops took over the occupation from the English Command. Whereas for Celebes, Borneo and the Moluccas new forms of administration were inaugurated, so that co-operation was effected with these regions, the territory of the Republic, comprising Java and Sumatra, remained on the whole inaccessible. Here disturbances continued, with infiltrations into the other territories.

Prolonged negotiations took place, and in mid-1947 the Dutch extended their occupation over the greater part of Java and over large areas of Sumatra. This is the state of affairs at the time this article is being written.

Early in the war, in December, 1942, H.M. Queen Wilhelmina of the Netherlands made a speech on the future political relations and the self-administration of the Netherlands Indies. The trend has been worked out in the following outline:

NETHERLANDS-INDONESIAN UNION.

Kingdom of the Netherlands.	*United States of Indonesia.*
The Netherlands.	State of East Indonesia.
Surinam.	State of Borneo.
Curaçao.	Banka, Billiton, Rhio.
	Republic of Java and Sumatra.

The pre-war departments of the Netherlands Indies Government are to be raised to Federal departments of these United States. The United States of Indonesia are to be formed by areas that are more or less independent units. Each *negara*† has its own ministers and its own government departments. It is subdivided into provinces (*daerah*) which in their turn again are to be regarded as units in view of the race or nature of their population, or by their geographical position. Each *daerah* is a self-administering unit.

It has been agreed upon that scientific research, and also the arts and higher education, shall be items pertaining to the Federal organs.

THE SCIENTISTS.

At the request of the Government of the Netherlands Indies, Mr. Frans Verdoorn prepared, to serve as a basis for post-war planning, a list of research workers in pure and applied science and technology at the time of the Japanese invasion. This list comprises 2,700 names.[1] Internment and the political disturbances have levied a terrible toll. The Royal Engineering Institute has lost 133 out of its 770 members. Some services lost as many as 30% of their personnel.

The scientific workers are now being given an opportunity of recuperating and catching up with the arrears in scientific development, due to the isolation of years. To this end "study assignments" are being granted, so that countries and institutions can be visited where great progress has been made during the war. By allowing priority of evacuation, workers were made available at fairly short notice for activities connected with reconstruction.

Assignments of this kind were granted to Government officials and to others not in Government service. These latter comprise, for example, representatives of non-governmental experimental stations and of large companies, and also men who carry on small industries or commercial enterprises of their own. The Government advances the travelling expenses of such private business men, to be adjusted later with their firms. Upon the completion of the "assignment" a report has to be submitted. In many cases the investigators have published their results in articles appearing in various periodicals.

In this way more than 270 assignments have been made. In view of the fact that various departments and enterprises happen to be interested in the same subject, the persons sent out to investigate were at times sent out in groups, as in the case of the "Erosion Commission", which comprised nine persons who were to study the surface erosion in the United States and to investigate the methods of its contravention.

Most of the assignments (240) were directed towards Europe and the United States. Ninety assignments were made to Holland combined with other countries in Europe, including also England. Such assignment visits were paid

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† "Negara" = "land" or "State".

[1] The list has been printed in "Science and Scientists in the Netherlands Indies" by Pieter Honig and Frans Verdoorn, 1945, p. 425 (see footnote below). It must be understood that all workers included in this list are not necessarily research workers in the strict sense of the word. The list includes the same kind of workers as does, for example, the well-known "List of Research Workers in Agriculture and Forestry in the British Empire".

also to the Middle East, West and South Africa, India, China, Japan, Australia and New Zealand.

THE UNIVERSITY AND THE INSTITUTES.

The work performed by the University and the institutes is one of the pillars of this country's prosperity. Those interested in a detailed description of the scientific research here before the war are referred to the book "Science and Scientists in the Netherlands Indies", compiled by Pieter Honig and Frans Verdoorn.[2]

The University.

In 1920 a Technical College was established at Bandoeng, supported financially by agricultural estates, commerce and shipping concerns. At this college young men received a technical training that corresponded with that at Delft, though it did not cover all branches of the technical sciences. Subsequently the following faculties were established: the Law College (Batavia, 1924), the Medical College (Batavia, 1927), the Civil Service Academy (Batavia, 1939), the College of Philology and Philosophy (Batavia, 1940). In 1940 these various Colleges were combined into the University of the Netherlands Indies.

The Japanese invasion put an abrupt end to higher education. In some of the institutes the staff was able to continue its activities. The "dangerous" ones on the teaching staff of the Medical College were taken into custody, thus beginning long years of peregrination from one internment camp to another, whilst those students who escaped internment were sent home.

The occupying forces, voicing considerable criticism of the "Dutch" higher education, established a medical training institute of their own, in which the period of training was considerably shortened. This, however, was simply a vocational college with a five-year course. The language of instruction was Malay, though clandestinely Netherlands books were often used, whilst also Dutch terms were employed where no Malay terms were available. The Japanese language was taught during three hours each week, and several hours per week were devoted also to Japanese "drill" (soldiers' school). Europeans were not admitted. At first no Chinese were allowed to participate, but later on some were made to attend.

After the Japanese had capitulated, university education was resumed. As long as conditions were still chaotic, an Emergency University was established (at Batavia), where education was continued on a limited scale and under difficult conditions.

Subsequently the University of Indonesia was established, this appellation being in accordance with the demands of the newly inaugurated period (by decree of March 13, 1947), comprising the faculties above enumerated, the Faculty of Jurisprudence being supplemented by a Chair in Social Science. Since then have been added the Faculty of Exact Sciences (June, 1947), the Faculty of Veterinary Science (June, 1947), and the Faculty of Economic Science (July, 1947), this latter Faculty having its seat at Macassar, thus extending the decentralization of the various faculties from Java to Celebes.

The Departmental Institutes.

The departmental institutes are more numerous than are those of the University, because, due to their historical development, many of the institutes were already established before the University developed. These institutes are charged with activities in pure and applied science and technology. In part they do mere routine work. There are also institutes that were established by private estates and enterprises, the outcome of their research, for obvious reasons, being accessible only to the members.[3]

Most of these institutes are situated in Java, and a few in Sumatra and Celebes. This will be readily understood if it is considered that thus far Java has been the seat of the Government and that many estate crops for export were developed in Java and only later were grown in the other islands.

During the Japanese occupation the institutes were placed under the management of militarized civilians who often tried to convince the military authorities of the importance of their activities and endeavoured to retain the original personnel. Thus it became possible for many scientific research workers to continue their activities. But gradually the Japanese lost interest in scientific research, whilst the supreme power of the military authorities caused the activities of the institutes to decline as the war proceeded. Nevertheless, many manuscripts were completed, of which but few were published during the war period.[4]

To obtain an idea of the adventures of these institutes we will here give a sketch of what happened at the Geological Museum at Bandoeng and to the institutes at Buitenzorg.

Immediately upon the Japanese occupation of the island of Java, the building housing the

[2] Published by the Board for the Netherlands Indies, Surinam, and Curaçao, New York City, 1945; Batavia: Noordhoff-Kolff; Melbourne: N. H. Seward.

[3] We may mention in this connection the Experiment Station, West Java, at Buitenzorg (for various crops); the Experiment Station of the Association of Sumatra Rubber Growers, at Medan, Sumatra; and the Java Sugar Experimental Station, at Pasoeroean, East Java.

[4] Various writings have been printed since the war, and a number of periodicals appear again, such as "Landbouw" (on agriculture); "Tectona" (on forestry); "Ned. Ind. Bladen voor Diergeneeskunde" (veterinary service); "Treubia" (botanic gardens); "Medisch Maandblad" (medical monthly); "Chronica Naturae" (continuation of "Natuurwetenschappelijk Tijdschrift voor Nederl. Indië", issued by the Royal Netherlands Indies Science Society); "Meteorological and Geophysical Survey Disquisitions".

Geological Museum was taken over by the Japanese army. As it had served as the headquarters of the Netherlands Indies Air Force, the scientific collections had been carefully stowed away. The Museum especially aroused interest, and one of the militarized Japanese civilians managed to explain that it was necessary for the European staff to be retained. This Japanese happened to have been, prior to the war, a corresponding member of the Royal Netherlands Science Society. Various geologists and engineers were thereupon released, the Geological Museum was put in order again, and research work could be continued. However, in October, 1943, nearly all the members of the staff were interned.

During the years of war the Japanese management did nothing of any practical importance. The buildings, many of the collections, and the laboratories were kept in good condition, especially the library, for the Japanese were careful with it and even added private books that had been stored away in the building. Still, there were private thefts and sales from museum property. In the early days of the Japanese occupation one of the safes, containing gold and diamonds from Borneo, had been robbed, while safes containing scientific material had been left untouched. At that time also a fine specimen of meteoric iron from Central Java disappeared. The theft of a Ngandon skull, *Homo soloensis*, was an important loss, though fortunately it was recovered in Japan after the war. Also some of the collections, as for example the fossil fishes from Sumatra, were dealt with so badly that they cannot be restored, and have become a total loss.

When the Japanese capitulated, the building was handed over to the Indonesians. Later fighting ensued between Indonesians and British Indian troops in the neighbourhood. A member of the staff, Tan Sin Hok, a well-known palaeontologist, was murdered by plundering bands.

In 1946 the work in the Geological Museum and in the Bureau of Mines could be resumed. The Indonesians had left the museum collections in a state of considerable disorder. Type material of the palaeontological collections had been lost. Gold and silver ores were taken, also many scientific instruments and appliances, microscopes, laboratory outfits, and all photographic instruments.

The famous Government Botanic Gardens at Buitenzorg were founded in 1817. Their first director stated that they should not only serve to grow many indigenous plants, but that one should be able in them to test provisionally the cultivation of other economic plants; and this view still prevails. Although these gardens were largely extended in the course of the next few decades, scientific research developed more specifically under the guidance of the director, Melchior Treub (1880-1905). In 1905 the work of the Gardens comprised practically all fields of botany, agriculture, horticulture, and zoology, at which time they were converted into a Department of Agriculture.

At a later date the activities were divided into the General Agricultural Experimental Station, pertaining to the Agricultural Service, and the Botanic Gardens, all of them within the province of the Department of Economic Affairs. The Experimental Station concentrates mainly on practical research, whereas the institutes of the Botanic Gardens are concerned more with purely scientific research. In addition, there are also at Buitenzorg institutes of the Forest Service and of the Veterinary Service, the Laboratory of Chemical Research, and the Rubber Experimental Station.[5] Seeing that these institutes are situated partly within the Botanic Gardens and partly in their vicinity, their lot these past several years has been closely inter-related.

The Japanese retained part of the personnel.[6] The gardens were closed to the public and were regarded as Imperial property. The Japanese supervisor ordered a new illustrated guide to be compiled, in English, and issued on the purpose of the Botanic Gardens. When this was out of print a new guide in Japanese was published.

As to the buildings, the new Physiological Laboratory, of which the foundations had been laid before the war, was completed. Unfortunately, inferior building material was used. Within the gardens themselves new roads were laid out. The medical herb gardens were enlarged and a good deal of cocoa was planted. Later on a number of food plants were added, "to help the farmer". As the war progressed the routine work slowed down. Considerable damage has been done to the rattan section, so that several type numbers are now lost to science. The work in the Treub Laboratory, in the Herbarium, in the Museum for Systematic Botany, and in the Zoological Museum was continued. Numerous manuscripts have been completed. As there was a shortage of paper, hardly any mounting of species could be done in the herbarium. The distribution of duplicates was stopped; extensive pre-war exchange sets were waiting to be shipped. A number of private collections, likely to be looted by the populace, their owners having been interned, were removed to the institutes, there to be taken care of, including the unique Bartel's collection of 16,000 birds' skins.

After the Japanese had capitulated extremists dominated the town. Scientific workers sought refuge in the camps. Within the neighbouring community of Indonesian Christians (at Depok) murder scenes were frightful. Urged by the Director of the Botanic Gardens, the British forces sent troops to Buitenzorg, where

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[5] To obtain a survey of the working programmes of the various institutes we refer to the chapters of the book "Science and Scientists in the Netherlands Indies", pp. 10, 55, 59, 123, 207, 215, 221, 226 and 399.

[6] Others were interned as P.O.W., suspected of collaboration, or else were dismissed.

they arrived in time to prevent worse. But their protection did not exceed that of the internment camps and a few institutes.

In December, 1945, the palace of the Lieutenant-Governor General, situated close to the Botanic Gardens, was occupied. The scientific staff managed to be admitted to some of the institutes. However, the lack of safety and the general disorganization were such as to make it practically impossible to work there. The Director of the Experimental Station for General Agriculture was kidnapped and murdered. In the course of this period serious damage was inflicted upon buildings and their inventories. It has been found, as a matter of fact, that illustrations were torn out of precious illustrated works, to be used as packing paper in the local market.

After the Dutch troops had taken over the occupation from the British, authority over the institutes increased. Their final occupation, however, was postponed so as not to interfere in any way with the negotiations then in progress with the Republic. It was not until in mid-1947 that the work in the institutes was resumed by their previous staffs.

Nature Protection and Private Associations.

In Java before the war 125,000 hectares of land had been declared to be game reserves and nature parks, and in the other islands more than two million hectares. These reserves contain elephants (Sumatra), dwarf rhinoceros (Java), orang-utan (Sumatra, Borneo), and the giant lizard (*Varanus komodensis*), which is found only in the small island of Komodo, and which may reach a length of three metres. These reserves have come into being through co-operation between the Government and private associations.

During the Japanese occupation the native personnel guarding these reserves was maintained, and all guns had to be handed in by the population. Still, poachers can always manage to kill wild animals without a gun.

It may be assumed that in those areas where the arms of the Japanese were taken over by the native population after the capitulation considerable damage has been done, and it may well be asked what has been left of the game in these reserves. The natives believe that certain parts of the dwarf rhinoceros confer invulnerability upon those who carry them; one cannot but be pessimistic concerning the last specimens of this species.

As matters developed, the activities of the scientific associations came to an end. Now, however, they have resumed their work. The Royal Indies Science Society in Batavia has reopened its library, and the Museum of the Royal Batavian Society of Arts and Sciences is now again open to the public. A section of the Royal Dutch Geographic Association is being re-established.

Co-ordination of Research Work.

The need of co-ordinating the research work is felt even more urgently now than before the war. The shortage of personnel and of material contributes to this state of things.

As is well known, in the United States, Russia and Germany these past several years a far-reaching concentration in the direction of scientific aims and activities has manifested itself. In those countries organizations have been established which, with practically unlimited financial support, are to advance agriculture and industry by means of scientific research. In this way, for example, the War Production Board had, for the U.S.A. and the British Empire, been given authority to call upon any institute to lend its resources to the war effort, to collect teams of research workers from various institutions, and to centralize institutes and institutions. In working out a problem it has become apparent that the technical relations, i.e., the direct co-operation between the various branches of research, are of more importance than are the administrative relations that may exist between the various institutions that happen to be concerned.

On the basis of this experience a Committee for Co-ordinating Scientific Research has now been established in the Netherlands Indies[7] and it is proposed to make this a permanent organization.[8]

[7] Under the chairmanship first of Prof. Dr. L. G. M. Baas Becking and subsequently of Dr. P. Honig.

[8] In compiling this paper the writer consulted various articles on the same subject in "Natuurwetenschappelijk Tijdschrift voor Nederlandsch Indië", 1946 (102), and its continuation "Chronica Naturae", 1947 (103). Certain passages therein have been taken over.

Two Climatic Systems Applied to Australia

DR. J. GENTILLI.*

Small-scale climatic maps of Australia have been compiled by Koeppen (1932) and Holmes (1938). In Thornthwaite's (1933) world climatic map Australia appears very small and distorted.

Assistance by the Council for Scientific and Industrial Research has enabled the writer to carry out a comparative study of Australian climates according to the systems of Koeppen and Thornthwaite, and two relevant maps have been prepared (Figs. 1 and 2). The precipitation and temperature records used were obtained from publications by the Council for Scientific and Industrial Research (C.S. & I.R., 1933) and the Commonwealth Bureau of Meteorology. The former give precipitation and temperature for over one hundred localities and the latter a very large number of annual precipitation data for almost every rain-gauge

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in Australia as well as monthly precipitation data for several hundred localities.

In the sparsely settled areas interpolations had to be made and monthly precipitation and temperature maps were used for this purpose (Watt, 1940).

The simplified definitions of the climates described by Koeppen (1932) and Thornthwaite (1931) and found in Australia are:

KOEPPEN:
- A = hot climate.
- B = dry climate (BS is semi-arid, BW is arid).
- C = warm climate.
- a = climate with hot summer.
- b = climate with temperate long summer.
- c = climate with temperate short summer.
- f = climate with uniform rain.
- g = climate with temperature maximum before the summer solstice.
- h = mean annual temperature warm.
- i = climate with small annual temperature range.
- k = mean annual temperature cool.
- m = dry season very short.
- s = climate with dry summer.
- w = climate with dry winter.

THORNTHWAITE:
- A = superhumid climate.
- A′ = hot climate.
- B = humid climate.
- B′ = warm climate.
- C = subhumid climate.
- C′ = cool climate.
- D = semi-arid climate.
- D′ = cold climate.
- E = arid climate.
- d = moisture deficiency in every season.
- r = good moisture in every season.
- s = great moisture deficiency in summer.
- w = great moisture deficiency in winter.

The main result of the investigation using Koeppen's system is the recognition of an *Am* climate in north-eastern Queensland, on a small area, sufficient to make a climatic region. There are small patches with an *Af* climate, such as Deeral, Innisfail, Babinda, Tully, but it is doubtful whether they could be classified as anything but micro-climates.

The *Aw* climate apparently does not occur along the coast east of the Atherton Tableland; however, it has a very interesting outlier south of the *Am* region, from near Ingham to Proserpine, as sugar-cane growers well know. The main section of the *Aw* region, with the exception of the outlier just mentioned, has its hottest time before the summer solstice, and could therefore be classified as a *g* climatic region. Another symbol which could be used is *i*, for the northernmost areas of Australia, which have a very small temperature range. Russell's introduction of an *A* boundary for the dry climates has been adopted elsewhere (Gentilli, 1946); it was decided not to use it in an investigation based upon Koeppen's basic types.

Most of the *BSwh* region could also be distinguished by *ag*. The *BSfh* region corresponds fairly closely to the grey and brown soils usually associated with semi-arid climates, as shown on the latest soil map (Prescott, 1944). In Western Australia, however, the *BSfh* region is not shown satisfactorily, and although its boundary from Shark Bay to Kalgoorlie is not very far from the boundary of the mulga, it does not coincide with it (Gardner, 1941). On the other hand, two *BSfh* outliers find a definite support in economic reality, as borne out by the existence of grasses in the Hamersley outlier (Gardner and Kessell, 1928) and of slightly better pastures in the MacDonnell outlier, in places shown as northern grasslands (McTaggart, 1936). As expected, the *BSsh* and *BSsk* regions are characterized by sclerophyllous vegetation, and one has to reach the *s/f* boundary near Norseman and Grass Patch before one meets natural expanses of grasses (Gardner, 1941). The *BWh* area is by far the largest Australian climatic region (Gentilli, 1946).

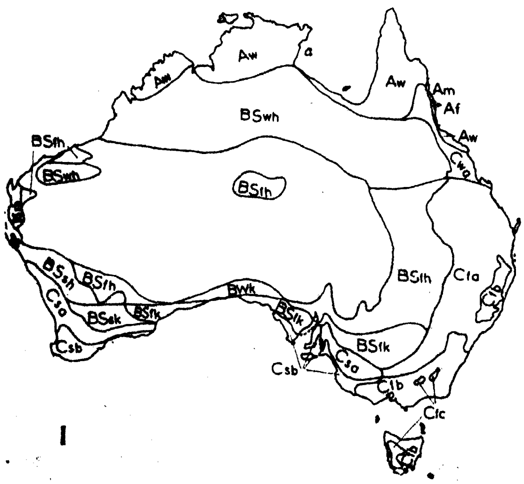

Figure 1. Australian climates according to Koeppen's system (1932).

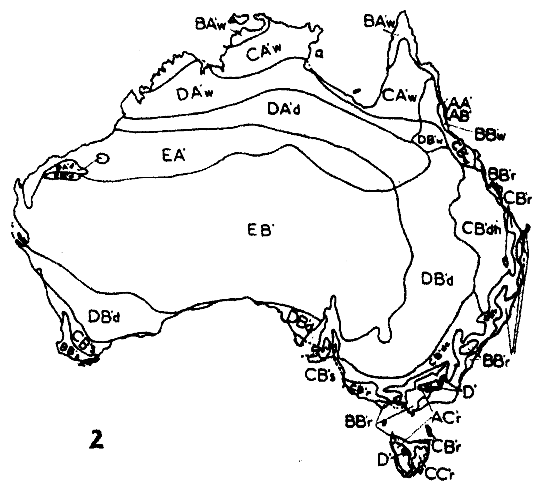

Figure 2. Australian climates according to Thornthwaite's system (1931). The small unnamed climatic area in South Australia corresponds to the Mt. Lofty region; its climate is BB′s and BB′r.

The *C* climates, typical of the European habitat, are poorly represented. *Cwa* forms an interesting strip which extends diagonally from the Atherton Tableland, a dairying area only 15° from the equator, to near Rockhampton on the coast; this region does not extend very far to the south. *Cfa* covers a narrow strip, from Rockhampton to Bendigo, with its widest section, about 350 miles, in Queensland. It is largely the black-earth climate (Taylor, 1940).

The southern section of the *Cfa* region is covered by red-brown earths, and Koeppen's system fails to bring out this difference; a line joining the localities where the wettest winter month receives at least as much rain as the second wettest summer month might provide a suitable boundary. There is another shortcoming with Koeppen's system; it does not provide for any difference in classification between the coastal areas, with a high precipitation and humidity, and the inland areas, where precipitation and humidity are very moderate. Vegetation studies show the importance of such a distinction (Cameron, 1935).

The *Cfb* region resembles the *Cwa* region in its diagonal-altitudinal layout. It reaches as far north as Toowoomba in Queensland and as far south as Tasmania, with a gap along the Hunter River Valley in New South Wales, which is of the greatest climatic and biological interest. It is through this gap that plants and animals from the interior are able to overcome the relatively steep and cool *Cfb* inland barrier. *Cfc* is poorly represented in Australia, and its two occurrences on the Australian Alps are little more than micro-climates. It is better represented in Tasmania, where it practically coincides with the now depleted pine forests.

Csa and *Csb* are well represented and are the home of the many south-western endemic botanical species of outstanding scientific interest. The *a/b* boundary is not very significant here, although it marks the northern limit of a number of introduced perennial fodder grasses (McTaggart, 1936).

No map of Australia on Thornthwaite's system was published before the present study was carried out. Whereas Koeppen's system permits the recognition of twenty climatic types (including *g* and *i*), Thornthwaite's permits the recognition of twenty-two. Without *g* and *i*, Koeppen's gives sixteen only. Work in South Africa (Schulze, 1947) gives eighteen climatic regions for the territory of the Union and South-West Africa if Koeppen's system is used in the same way as in the present paper, and twenty-seven regions if additional subdivisions are adopted. The same work gives only fourteen regions as obtained by using Thornthwaite's system in the same area. Entirely different results were obtained by research conducted in New Zealand (Garnier, 1946), according to which there are in New Zealand six climatic regions according to Koeppen's system and twelve according to Thornthwaite's system if minor subdivisions are omitted. Koeppen paid more attention to the details of hot-climate classification, whereas Thornthwaite evolved his system as the most satisfactory way of classifying the climates of North America, typically a cool to cold environment.

Thornthwaite's *C/D* boundary corresponds to Koeppen's *A/B* and *C/B*. While there is hardly any appreciable difference between these boundaries in uniform-rain regions, Thornthwaite's system reduces the area of summer-dry regions. Koeppen's *s* and *w* cover much larger areas than Thornthwaite's *s* and *w*; on the other hand, Thornthwaite distinguishes between *r* and *d*, whereas Koeppen uses an all-embracing *f*, covering all regions which are neither *s* nor *w*.

Thornthwaite's system recognizes three different moisture climates (*A*, *B*, *C*), whereas Koeppen's system admits one (*A*-*B*) only. Thornthwaite's hot desert (*EA'*) is a relatively thin strip north of 22° S.; Koeppen's hot desert (*BWh*) is a huge area extending as far south as 30° S. Plants and soils apparently fail to bear out either boundary. The adoption of the *A* temperature boundary within the *BW* region gives results not very far from those obtained with Thornthwaite's system. On the other hand, the south-western boundary of Thornthwaite's *EB'* is more satisfactory than Koeppen's corresponding *BWh* boundary because it closely agrees with the boundary between mulga and sclerophyllous woodland, a boundary of the greatest ecological and economic importance (Gardner, 1941).

The map (Fig. 2) on Thornthwaite's system shows a semi-arid (*DA'd*, *DB'd*) inlier in the north-western (Hamersley) section of the desert, borne out by botanical boundaries (Gardner, 1941), but does not show any inlier in the central (MacDonnell) section; this may agree with soil and vegetation boundaries (Prescott, 1932 and 1944), although there is no doubt that pockets of semi-arid climate occur at secluded spots in the MacDonnell Range. The presence of land mollusca even suggests the existence of humid micro-climates (Cotton, 1946).

Thornthwaite's *DA'w*, *DA'd* and *DB'w* correspond to Koeppen's *BSwh*, but the information available is not sufficient to comment on these boundaries and subdivisions. Thornthwaite's *DB'd* corresponds to Koeppen's *BSfh* and *BSfk*, and also to part of *BSs*. The western and southern sections of *DB'd* give a striking outline of the sclerophyllous woodland region, including mallee and heath (Gardner, 1941), but the eastern section is not equally satisfactory.

By using Koeppen's system there is one climate only (*Cfa*) between Roma and Fraser Island, whereas by using Thornthwaite's system one can recognize three climates (*CB'd*, *CB'r*, *BB'r*). This is an all-important distinction, because *CB'd* almost perfectly corresponds to the black-earth area, while *CB'r* and *BB'r* correspond to podsolized soils (Prescott, 1944), presumably with different degrees of podsoliza-

tion. *CB'r* generally corresponds to the sclerophyllous forest, *BB'r* to the wet sclerophyllous forest (Prescott, 1932) and to perennial pastures (McTaggart, 1936).

CB'd extends for a considerable distance southwards, and south of Narrabri the black earths merge into the red-brown earths. A new climatic subdivision has been evolved: *CB'dh* gets more than half its precipitation effectiveness in the hotter six months; *CB'dc* gets more than half its precipitation effectiveness in the cooler six months, this being one case in which the notation $C_3B'c$ and $C_3B'h$ would be convenient. The way in which *CB'dc* corresponds to the red-brown earth belt is remarkable, with two exceptions. At the southern end of Yorke Peninsula red-brown earths are not shown on soil maps, but the corresponding type of vegetation is found. Prescott (1932) shows a sclerophyll forest here, while McTaggart (1936) shows an open forest. Wood (1937) shows vegetational features which agree with the climatic boundaries on Thornthwaite's system. The other exception is found near the Coorong, where soils are greatly affected by cyclic salt and the pattern is altered.

While *CB'r* corresponds to podsolized soils, *CB's* corresponds both to podsolized soils and red-brown earths (Teakle, 1938). The boundary between podsolized soils and red-brown earths is shown by the boundary between the C_3 and C_4 climatic subdivisions suggested above, so that $C_3B's$ is the red-brown earth region and $C_4B's$ the podsolized soil region, which merges into *BB's* where podsolization generally increases. The typical trees seem to be: for $C_4B's$, *Eucalyptus calophylla* or marri; for $B_6B's$, *E. marginata* or jarrah; for $B_6B's$, *Casuarina fraseriana* or sheoak; for $B_7B's$, *E. diversicolor* or karri; and possibly for a disappeared $B_8B's$, *E. jacksoni* or red tingle (Lane-Poole, 1920). Sclerophyllous conditions are much more pronounced in *s* than in *r* climates.

BA'w may also correspond to a sclerophyll forest; authorities disagree as to the exact classification of the vegetation in the Darwin-Arnhem area, and very little is known of the vegetation of Cape York Peninsula. *CA'w* is the climate of the hot savanna woodland, in close agreement with Koeppen's *Aw*.

AA' and *AB'* are the climates of the rain-forest. There are small pockets of rain-forest which do not find their climatic counterpart here, but this is due to the fact that they occur in gullies or in moisture-retaining basaltic soils. It is interesting to note that Thornthwaite's *AA'* has its counterpart in Koeppen's *Af* and, partly, *Am*, but there is no counterpart for *AB'*, and certainly not for *AC'*, which is the climate of the cool rain-forest and covers small areas in the south-east and in Tasmania, where it gives rise to a typical rain-forest not found elsewhere on the mainland (Stephens, 1941). It is possible that $B_6C'r$ is the climate of *E. regnans* or mountain ash, $B_{5-6}C'r$ the climate of *E. gigantea* or alpine ash, *AC'* the climate of the myrtle beech (Carter, 1946).

D' is the climate of mountain moors (Prescott, 1932; Stephens, 1941). A large map showing the detailed location of this climate in Tasmania has recently been published (Gentilli, 1948).

Among other notable points explained by the map on Thornthwaite's system are the *CB'dc* grassland west of Melbourne; the *BB'* forest area on Mount Lofty Range; the *CB'dc* and *CC'd* areas near Canberra and Cooma, corresponding to grasslands with some trees in the more favourable locations; the *CC'* area in central eastern Tasmania with a similar vegetation; the almost micro-climatic pocket of *CB'dc* south-east of Port Augusta, a grassy woodland now colonized by perennial pasture plants; and the *DB'd* mallee area in the lee of Kangaroo Island.

It appears, from this survey, that Thornthwaite's (1931) system is more satisfactory than Koeppen's (1932) system for the study of climatic regions of middle and high latitudes, while the reverse is true of low latitude climatic regions.

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News

British Association

The British Association for the Advancement of Science will meet at Brighton in the period 8–15 September. The programme will include: achievements of X-ray analysis, newer metals and alloys in industry, geology today and tomorrow, biology in schools, colonial development, movements of population in the Commonwealth, the metric system, building materials, human blood groups, colour vision, changing aspects of nutrition, selection of university students, problems of old age, aspects of world education, administrator and teacher, maintenance of world food supply, forestry and the community.

The President of the Brighton meeting is Sir Henry Tizard, and the Presidents of Sections are: *Mathematics and Physics*, Sir Lawrence Bragg; *Chemistry*, Professor Sir John Read; *Geology*, Dr. A. E. Trueman; *Zoology*, Professor H. Graham Cannon; *Geography*, Lord Rennell of Rodd; *Economics*, Sir Hubert Henderson; *Engineering*, Professor T. R. Cave-Brown-Cave; *Anthropology and Archaeology*, R. U. Sayce; *Physiology*, Professor H. Hartridge; *Psychology*, Professor A. Rex Knight; *Botany*, Professor J. R. Matthews; *Education*, O. Lester Smith; *Agriculture*, Dr. G. Scott Robertson.

Royal Society of London

The following is a list of recent elections made to the Fellowship of the Royal Society, showing the particular field of each new Fellow: Dr. T. E. Allibone, high-voltage phenomena; Dr. F. P. Bowden, friction and lubrication; H. Constant, thermodynamics and aerodynamics of aircraft engines; Dr. S. F. Dorey, marine engineering; E. H. Farmer, complex unsaturated hydrocarbons; Professor O. R. Frisch, fission processes in nuclear physics; Sir John Fryer, agricultural science and applied entomology; Professor T. M. Harris, palaeobotany; Professor W. H. Heitler, theoretical physics; A. L. Hodgkin, nervous conduction; Dr. G. M. Lees, stratigraphical and structural oil geology; Professor R. A. McCance, metabolic studies of human beings; Dr. K. Mahler, theory of numbers; Dr. Sidnie M. Manton, crustacea and other invertebrates; Dr. Dorothy M. Needham, biochemistry of muscle; Professor J. H. Orton, marine biology; Sir Leonard Parsons, child health and wasting disorders; Dr. Stanley Peat, constitution and synthesis of carbohydrates; Professor G. W. Robinson, study of soils; Dr. W. A. H. Rushton, electrical stimuli on muscles and nerves; J. W. Ryde, pure and applied physics; G. R. S. Snow, plant hormones and growth; Dr. E. W. R. Steacie, gaseous chemical reactions; Dr. J. A. Todd, geometry of figures; Dr. F. Yates, statistical analysis of agricultural problems.

Entomological Society of Queensland

The Silver Jubilee meeting of the Entomological Society of Queensland was held in the Entomological Laboratory of the University of Queensland on 12 July, 1948. The President, Dr. I. M. Mackerras, was in the chair. The principal speaker was Mr. F. A. Perkins, a foundation member, who gave an account of the history of the Society since its formation in 1923. He paid special tribute to Mr. G. H. Hardy, through whose effort the Society started; to the late Professor E. J. Goddard, who was president for the first seven years and had seen that it was established on scientific lines with a broad outlook; and to Mr. J. L. Froggatt, the first secretary. Mr. Perkins said that the outstanding feature of meetings had been the quality of the exhibits, which probably did more to foster the Society than any other factor. Country members constitute the bulk of the Society and their interest has been sustained by the full and graphic nature of the minutes of meetings as circulated.

Two of the original objectives of the Society have not been fulfilled. One was the production of a periodical devoted entirely to entomology, which is beyond the means of the Society. The other was the formation of an Entomological Society of Australia. As the Queensland Society includes members from all parts of Australia and as similar societies formed in other States have not survived, it is a matter of regret that this objective has not been carried out.

Other foundation members who spoke at the meeting were Messrs. G. H. Hardy, H. Hacker, L. Hitchcock, J. H. Simmonds and H. Pottenger. Dr. Mackerras, in concluding the discussion, supported a suggestion that the future development of the Society would turn towards the integration of entomological ideas and the advancement of general biological thought.

Commonwealth Scientific Liaison Offices

The *British Commonwealth of Nations Scientific Liaison Offices (London)* have been opened in Africa House, Kingsway, W.C.2. This is one of the measures to facilitate co-operation in the civil aspects of science within the British Commonwealth decided on by the Scientific Official Conference held in London in 1946. For a number of years several of the Commonwealth countries have maintained scientific liaison offices in London. These, together with the ones about to be established, will continue to operate as in the past, retaining complete independence of action. For ease of reference to the group of offices as a whole the title given in italics above has been chosen, with the abbreviation B.C.S.O. (London) for common use. It should be noted that the title is in the plural.

The offices taking part in the scheme are the Scientific Liaison Offices of Australia, Canada, the Central African Council, India, New Zealand, South Africa, and the United

Kingdom. Pakistan and the Commonwealth Agricultural Bureaux will be represented and the Overseas Liaison Division of the U.K. Department of Scientific Research will also work in Africa House. In Washington the scientific liaison offices of the British Commonwealth countries are associated under a similar scheme.

Academia Sinica

The National Academy of China was founded in 1928 by the late Tsai Yuen-Pei and is now being reconstituted by the National Government. An initial roll of from eighty to one hundred academicians is to be elected by universities, learned societies and research institutions, grouped in the three categories of mathematical and physical sciences, biological sciences, and social sciences and the humanities. New members will be elected by the academicians themselves, to a maximum number of fifteen in each year. Membership is for life. For the position of director the National Government makes the appointment by selection from three names submitted by the Council of the Academy, which depends upon the National Government for financial support.

In addition to conferring the distinction of membership on leading scientists and generally furthering scientific research, the Academy controls thirteen research institutes—in Mathematics, Astronomy, Physics, Chemistry, Geology, Zoology, Botany, Meteorology, History and Philology (including Archaeology and Ethnology), Social Sciences, Medicine, Engineering, Psychology. Provision exists for the addition of a further ten institutes. Each has a staff of research fellows, associates, assistants and junior assistants, with technicians and clerks. For the war years, 1937-45, the various institutes retreated to Chungking, Li Chuan (Szechuan) and Kunming (Yunnan), with as much of their equipment as practicable. In the present stage of rehabilitation, temporary provision has been made for some of the institutes in Shanghai, while the other institutes and the administrative offices are at Nanking, where all will eventually be housed. Losses in books and equipment are gradually being replaced.

The Natural Science Society of China

The Natural Science Society of China was founded by a group of young scientists in 1927 to promote the advancement of science and technology in China. During the eight years of war, 1937-45, its membership grew from five hundred to over two thousand. Besides publishing original research the Society edits a monthly journal of popular science under the title *Scientific World* and issues a quarterly news bulletin to its members. It publishes text-books in science from research level to school level, and provides Chinese scientists with abstracts and mimeographed copies of work published abroad. It provides a regular news service for Press and radio; sponsors popular lectures and group discussions and arranges scientific exhibitions in various parts of China. During the war it conducted two scientific expeditions, one to southern Kuku Noir and the other to the Tibetan Borderland, comprising geographers, meteorologists, geologists, botanists and engineers. In addition to publishing the usual reports of these expeditions, the Society popularized their results by exhibitions displaying specimens and information gathered.

The Society is undertaking the establishment of *Science Centres* in Nanking and Shanghai. Each will include a library, lecture hall, demonstration laboratory, broadcasting station and exhibition hall. The Society is also establishing an Analytical Laboratory in Shanghai, to meet the demand for services in chemical analysis.

"Science and Technology in China"

During the war years the Natural Science Society of China, in co-operation with the British Council in China, published a journal of original research under the title *Acta Brevia Sinensia*. Nine numbers were issued, the last appearing in 1945. The Society has now undertaken the publication of a journal with wider scope, entirely in English, under the title *Science and Technology in China*. It will contain abridged reports of original research, articles reviewing progress in various fields, reports of institutions and societies, and the usual news, notes and book reviews. It is to be issued six times a year, the first number having appeared in February, 1948. This issue has brief abstracts of papers from the annual meeting of the Chinese Physical Society, and various reports and articles of interest, including one upon "A New General Method for the Synthesis of α-Amino Acids, Based on Hofmann's Degradation Reaction".

Editorial material is to be sent to the Editor-in-Chief, c.o. Institute of Chemistry, Academia Sinica, 320 Yo Yang Road, Shanghai. Subscriptions are at the rate of 40 cents (American) per issue or two dollars (American) per annum, and should be sent to S. H. Doo, 7137 Pennsylvania Ave., Pittsburgh 8, Pa., U.S.A.

Canadian Journal of Mathematics

The Canadian Mathematical Congress was first organized in 1945 and will hold its next meeting in 1949 at the University of British Colombia. It has arranged to found a new journal, the *Canadian Journal of Mathematics*, to be issued quarterly from January, 1949. From the composition of the editorial board and its associates, and the contents announced for the first issue, it appears that the journal will be of high value. The chief languages will be English and French.

Editorial matter should be sent to the Editor-in-Chief, H. S. M. Coxeter, University of Toronto. Subscriptions are at the rate of six

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

August, 1948

EDITOR: N. H. WHITE, Faculty of Agriculture, Sydney University, Sydney.

All communications concerning abstracts should be addressed to the Editor.

Vol. 27 **No. 1**

Chemistry 14605–14649

CHEMISTRY.

Hon. Abstractor: F. P. J. Dwyer.

14605. **Baker, S. C.** The Spectrographic Analysis of Steel. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 227.—The experimental conditions for the analysis of Si, Mn, Cr, P and Mo in steels have been examined. Eleven references.

14606. **Barclay, G. A., and Nyholm, R. S.** A Note on the Preparation of Some O-Carboxy Phenyl-Arsine Derivatives. *J. Proc. Roy. Soc. N.S.W.*, lxxxi, 1947, 77.—O-carboxy-phenyldichlorarsine I was prepared from O-carboxyphenyl arsonic acid by reduction with sulphur dioxide in concentrated hydrochloric acid solution. Recrystallized from toluene I gave white needles, m.p. 156° C. O-carboxy-phenyl dimethylarsine II was prepared from I by reaction with methyl magnesium iodide. II melted at 133° C., was insoluble in water but soluble in alkalis.

14607. **Bayliss, N. S., and Ewers, W. E.** The Thermodynamics of Some Reactions Involving Alumina and Anhydrous Aluminium Chloride. *J. Aust. Chem. Inst.*, xiv, 1947, 504.—Thermodynamic data have been assembled in order to predict the feasibility of reactions for making anhydrous aluminium chloride from alumina and hydrogen chloride or metallic chlorides. Most of the reactions are unfavourable. Recent thermodynamic data pertaining to aluminium oxide and the anhydrous chloride have been reviewed. Eighteen references.

14608. **Berry, P. A.** The Preparation and Characteristics of Certain Terpene Tetrabromides. *J. Aust. Chem. Inst.*, xiv, 1947, 376.—By aspirating bromine vapour through solutions of terpene fractions of *E. Cneorifolia* in acetic acid a crystalline tetrabromide was obtained. *Nature*, clvi, 1945, 175.—The same method has been used to prepare the tetrabromides of limonene, dipentene and chenopodium oil.

14609. **Berry, P. A.** Examination of the Terpenes Contained in the Oil of *E. Cneorifolia*. *J. Aust. Chem. Inst.*, xiv, 1947, 383.—The oil has been found to contain, in the flush period of leaf growth, 58% of terpenes and less than 1% of cymene. The presence of α- and β-phellandrene in large amounts and dipentene in small amount has been confirmed.

14610. **Berry, P. A.** L-β Phellandrene. *J. Aust. Chem. Inst.*, xiv, 1947, 387.—β-phellandrene from oil of *E. cneorifolia* undergoes polymerization, with optical inversion, on distillation. The purest substance, obtained by the debromination of the dibromide, has a specific rotation of −74·4°. The preparation of the pure nitrosochloride (m.p. 109°) and its mutarotation are described.

14611. **Berry, P. A.** The Action of Bromine on α-Phellandrene. *J. Aust. Chem. Inst.*, xiv, 1947, 373.—The reaction of bromine and α-phellandrene has been found to yield a highly brominated mixture containing much more bromine than is required to form phellandrene dibromide. Cymene and very large amounts of hydrobromic acid are also formed.

14612. **Billitzer, A. W.** A Magnetic Stirrer for Dean and Stark Traps. *J. Aust. Chem. Inst.*, xv, 1948, 165.—The device uses a thin steel spiral inside the trap. The spiral is moved about by a horseshoe magnet on the outside.

14613. **Bland, D. E., Hanson, E. A., Stewart, C. M., and Watson, A. J.** The Extraction of Lignin from *Eucalyptus regnans* by Means of Methanol. *J. C.S.I.R.*, xx, 1947, 553.—Extraction of the wood of *Eucalyptus regnans* with methanol for 24 hours removed 25% of the lignin, whilst 148 hours' extraction, using fresh methanol every 16 hours, removed 70% of the original lignin estimated as Klason lignin.

14614. **Bolliger, A., and Tow, A. J.** Studies of Colour Reaction for Sugars. Part ii. The Isolation of the Precursor and of the Blue Compound Obtained by Interaction of Thymol, Hydrochloric Acid and Formic Chloride with Glucose. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 178.—The precursor I of the Blue Compound II was isolated by chromatographic adsorption, from ethylacetate-benzene, on aluminium oxide. The compound I was obtained in yellow rods, m.p. 283° C., and had the formula $C_{40}H_{44}O_5$. Treatment of I with alcoholic hydrochloric acid gave I*a*, a maroon powder, m.p. 277° C. Analysis of I*a* showed the formula $(C_{40}H_{44}O_{52})HCl.H_2O$. The substance II*a*, made by oxidation of I with ferric chloride, was found to be $C_{80}H_{86}O_9$. The deep purple crystals, m.p. 232° C., turned blue on the addition of hydrochloric acid to give II, a dark blue solid $(C_{80}H_{88}O_9)2HCl.3H_2O$. Oxidation and simultaneous chlorination of I gave III—$C_{80}H_{86}O_9Cl_8$—almost black crystals m.p. 140° C. By energetic oxidation of I with 30% hydrogen peroxide in hydrochloric acid IV was obtained, $C_{20}H_{20}O_3Cl_4$, orange needles m.p. 168° C. Compound I gave an acetyl and benzoyl derivative, m.p.'s 165°, 181°.

14615. **Bowman, R. P., Fitzgerald, J. S., and Jensen, Florence M.** The Water Absorption of

Phenol-formaldehyde Resin Mouldings. *J. C.S.I.R.*, xx, 1947, 503.—The water absorption by moulded phenolic resins conforms to the diffusion equation with an accuracy that depends on the filter used. Thin specimens may be used to obtain a measure of the saturation limit of mouldings but the total percentage of water absorbed varies with the thickness of the specimens. It is concluded that for satisfactory comparison the rate of penetration of water and the saturation value must both be measured. Twenty-five references.

14616. **Briggs, L. H.** Plant Products of New Zealand. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 151.—Liversidge Research Lecture. A review of the essential oils of many New Zealand plants. Two hundred and five references.

14617. **Cane, R. F.** The Chemistry of the Pyrolysis of Torbanite. *J. Aust. Chem. Inst.*, xv, 1948, 62.—The breakdown of torbanite to form oil is one of thermal cracking involving several stages. The initial decomposition occurs below 350° C. and oil can be detected definitely at 325° C. The chief product of the first stage is a rubber-like material showing swelling and other elastometric characteristics. The secondary product is similar to bitumen, but more paraffinic, and the crude shale oil results from this bitumen-like material.

14618. **Carter, N. L.** The Determination of Aluminium in Aluminium-Zinc Alloys. *J. Aust. Chem. Inst.*, xiv, 1947, 342.—The lithium aluminate method has been shown to be the most satisfactory gravimetric procedure for alloys with less than 1% Al.

14619. **Cole, E. R.** The Colorimetric Estimation of Apomorphine. *J. Proc. Roy. Soc. N.S.W.*, lxxxi, 1946, 80.—The method depends upon the condensation of apomorphine with 2 : 6 dibromoquinone chlorimide in the presence of sodium bicarbonate. Extraction with butyl alcohol removes the coloured derivative-blue to purplish blue. The method has been applied to the assay of hypothermic tablets.

14620. **Cox, C. I.** The Development and Operation of a Process for the Manufacture of Barium Nitrate 1941–1944. *J. Aust. Chem. Inst.*, xv, 1948, 77.—The wartime development and full-scale operation of a process for the manufacture of barium nitrate from barytes is described. The route of manufacture was barium sulphide, barium carbonate, and finally the nitrate. An over-all yield of barium nitrate on barytes of about 60% was achieved.

14621. **Dwyer, F. P., and Nyholm, R. S.** The Chemistry of Ruthenium. Part ii. Complexes of Diphenyl-Methyl Arsine with Trivalent and Divalent Ruthenium Halides. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 217.—Unlike iron, ruthenium III halides form only simple unbridged complexes with diphenyl-methylarsine of the type $RuX_3.3AsR_3$. These were prepared by refluxing the arsine, 3 mols, in aqueous alcoholic solution with potassium aquo-pentachloro-ruthenate III for the chloro complex, and in the presence of potassium bromide or iodide for the bromo and iodo compounds. The red chloro compound, m.p. 139° C., the blue bromo compound, m.p. 135°, the dark brown iodo compound, m.p. 130° C., were all soluble in benzene and chloroform. Reduction with hypophosphorous acid gave the yellow ruthenium II complexes $RuX_2.4AsR_3$. These complexes were also soluble in organic solvents and reduced silver nitrate solutions to silver metal.

14622. **Dwyer, F. P., and Backhouse, J. R.** Pyridine Co-ordinated Iodine Salts of Diazoamino Compounds. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 220.—The silver salts of 3 : 3′, 3 : 4′ and 4 : 4′ dinitro diazoaminobenzene reacted in pyridine solution with the formation of silver iodide and monopyridine-N-iodo-diazoamino compounds as yellow crystalline substances $(C_6H_4NO_2)_2N_3.I.C_5H_5N$. In these compounds the iodine functions as a two-covalent cation and has very pronounced oxidizing properties. The compounds melt with decomposition liberating iodine, they are insoluble in covalent solvents, but are soluble in alcohol and acetone. The co-ordinated pyridine may be removed with very dilute nitric acid in the presence of ether when highly unstable yellow ring compounds of bivalent iodine result.

14623. **Dwyer, F. P., and McKenzie, H. A.** A Note on the Instability Constant of the Tris 2 : 2′ Dipyridyl Ferrous Ion. *J. Proc. Roy. Soc. N.S.W.*, lxxxi, 1947, 97.—The instability constant of the tris 2 : 2′ dipyridyl ferrous ion was determined by adding a known excess of 2 : 2′ dipyridyl to an equimolar mixture of ferrous and ferric sulphate and determining the potential charge on a platinum electrode. Since the ferris complex does not form under the experimental conditions used, the potential change can be ascribed to the reduction in the ferrous ion concentration by complex ion formation, and the instability constant can be calculated. The value found was $1 \times 10^{-16 \cdot 4}$.

14624. **Dwyer, F. P., and McKenzie, H. A.** The Oxidation Potentials of the Tris 1 : 10 Phenanthroline and Tris 2,2′ Dipyridyl Ferrous Ions. *J. Proc. Roy. Soc. N.S.W.*, lxxxi, 1947, 93.—The oxidized form of each of the above ions was obtained by oxidation with chlorine and isolated as the blue crystalline perchlorates $Fe(o,phen)_3(ClO_4)_3$ and $Fe(dipy)_3(ClO_4)_3$, whose purity was demonstrated by analysis. Equimolar solutions of both the oxidized and reduced form of each complex were mixed at 25° C. with various concentrations of acid. In 0·103 N. sulphuric acid the redox potentials were 1·102 and 1·071 volts, respectively.

14625. **Dwyer, F. P., Humpoletz, J. E., and Nyholm, R. S.** The Chemistry of Osmium. Part ii. The Redox Potential of a Trivalent-Quadrivalent Osmium Couple in Hydrochloric Acid. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 242.—Solutions of potassium hexachlorosmate IV, in hydrochloric acid, can be reduced to potassium hexachlorosmate III by means of silver wool in an inert atmosphere provided that the acid concentration is kept about normal. The reduction requires some days. The redox potential of this trivalent-quadrivalent osmium system in hydrochloric acid was found to fall with increasing acid concentration. The value extrapolated to zero acid concentration was 0·452 volt, which is the same as the bromosmate IV-bromosmate III system in hydrobromic acid. It is concluded that the ions present are OsO^+ and OsO^{++}.

14626. **Dwyer, F. P., Humpoletz, J. E., and Nyholm, R. S.** The Chemistry of Ruthenium. Part i. The Redox Potential of the Tris-orthophenanthroline Ruthenous Ion. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 212.—A number of highly stable orange red salts of the tris-orthophenanthroline ruthenous ion have been prepared from tris-orthophenanthroline ruthenium II chloride. This substance, which is very soluble in water, arises from the reduction of mixtures of potassium pentachloro - hydroxyruthenate and o - phenanthroline with aqueous hypophosphorous acid at 100° C. The iodide and perchlorate are sparingly soluble in water and easily obtained from the chloride by double decomposition. The free base, $Ru(o\text{-}phen)_3(OH)_2$, is a strong base which precipitates metallic hydroxides and liberates ammonia from ammonium salts. The redox potential of the tris-orthophenanthroline ruthenous ion was determined from titration curves with ceric nitrate or sulphate and ranged from 1·29 volts in normal nitric acid to 1·105 volts in 13·5 normal sulphuric acid.

14627. **Dwyer, F. P., McKenzie, H. A., and Nyholm, R. S.** The Chemistry of Osmium. Part i. The Redox Potential of a Trivalent-Quadrivalent Osmium Couple in Hydrobromic Acid. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 181.—The potentials of the trivalent-quadrivalent osmium couple have been determined in various concentrations of hydrobromic acid. Solutions of potassium hexabromosmate^{IV} in dilute hydrobromic acid were reduced by silver wool in an inert atmosphere to the nearly colourless potassium hexabromosmate^{III}, and then mixed with an equivalent amount of the unreduced compound. Equilibrium was established slowly in an inert atmosphere, and from the behaviour in various acid concentrations it is considered that the system is essentially cationic. The value of the redox potential extrapolated to zero acid strength is 0·452 volt.

14628. **Farrer, K. T. H.** The Vitamin B Complex: Recent Advances of Interest to Food Chemists. *J. Aust. Chem. Inst.*, xiv, 1947, 329.—A review of analytical and microbiological methods of assay. Twenty-three references.

14629. **Friend, J. A.** A Note on the Estimation of Some Aromatic Hydroxy Compounds. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 224.—A method for the visual colorimetric estimation of derivatives of p-hydroxy benzoic acid, using Folin and Ciocalten's $HgSO_4/NaNO_2$ reagent, is described. The method was satisfactory (1%) over the range of concentrations from 0·1 to 5 mm. Amyl acetate occasionally interfered, possibly due to mercuration of the esters.

14630. **Gillam, N. W.** Changes of Iodine Value During the Processing of Fats and Oils. *J. Aust. Chem. Inst.*, xv, 1948, 126.—During the processing of fats and oils, during which polymerization and oxidation occurs, the iodine value is affected by the reaction of the double bonds. Some of the reactions that occur lower the I.V., others raise it, whilst others have little or no effect. The reactions which lead to either of these possibilities are discussed. Thirty-seven references.

14631. **Gillam, N. W.** Esterification Reactions in the Oxidation of Unsaturated Fatty Oils. *J. Aust. Chem. Inst.*, xv, 1948, 150.—Olive, castor and rape-seed oils were oxidized at low and high temperatures and the "free fatty acid ratio" determined. It is considered that large molecules with high "ratios" are built up by esterification between hydroxyl and carboxyl groups formed during oxidation. Castor oil with original free OH groups gives higher ratios than does olive oil. Other reactions, some eliminating water and some breaking carbon chains, are also involved. Twenty references.

14632. **Gillam, N. W.** Observations on the Determination of Acetyl Values. *J. Aust. Chem. Inst.*, xiv, 1947, 319.—A modified André-Cook procedure for acetyl values on a semi-micro scale is described. With oxidized fatty acids the acetylated substances can be fractionated in hydrocarbon solvents. Thirty-one references.

14633. **Gillam, N. W.** The Oxidation of Wool Wax. *J. Aust. Chem. Inst.*, xiv, 1947, 362.—Esters and free organic acids are obtained by oxidizing samples of wool wax alcohols at 60° C. for 300 hours. This is correlated with the increased acidity of stored greasy wool. To interpret the products formed the existence of cyclic esters and hydroxylated cyclic esters is postulated.

14634. **Heulin, F. E.** The Determination of Ascorbic Acid. *J. Aust. Chem. Inst.*, xiv, 1947, 498.—A summary of the methods available for the determination of ascorbic acid in processed foods. Various methods have been proposed for eliminating errors due to sulphurous acid and ferrous iron. Twenty-two references.

14635. **Hickinbotham, A. R., and Ryan, V. J.** Glycerol in Wine. *J. Aust. Chem. Inst.*, xv, 1948, 89.—The glycerol ratio of Australian wines ranges from 6·0 to 9·1 (mean 7·0) for the Hock types and from 4·6 to 7·7 (mean 6·4) for the Claret types and is much lower than European wines but similar to Californian wines. From experiments with four juices, fermented with four yeasts at four different temperatures ranging from 13°–36° C., it is demonstrated that low temperatures favour the production of glycerol, and also the yeast race is important.

14636. **Huggins, P.** Thermal Value of Fuel Oils by Correction of the Dulong Formula for Heat of Formation. *J. Aust. Chem. Inst.*, xv, 1948, 47.—The usual empirical formula of Dulong for the thermal value of a fuel as calculated from the ultimate analysis gives results which are 4–6% too high. This discrepancy arises from the fact that the formula does not take into account the heats of formation of the compounds present in the fuel. The heat of formation can be obtained from the average molecular weight, and the average molecular formula. From the ratio C/H the heat of formation is deduced graphically and this value subtracted from the thermal value of the Dulong formula. From 63 fuel oils the greatest variation from the corrected to the experimental figure was found to be +0·33% and the least +0·001%.

14637. **Hunt, C. H., and Reuter, F. H.** The Purification of Paraldehyde. *J. Aust. Chem. Inst.*, xv, 1948, 122.—The removal of peroxides from commercial paraldehyde is most conveniently achieved by removal of organic acids by brine and alkali, followed by distillation to destroy peroxidic

substances. A second treatment in the same way yielded a substance free from both acid and peroxide.

14638. **Lahey, F. N.** The Occurrence of Ursolic Acid in *Goodenia Ovata*. *J. Aust. Chem. Inst.*, xiv, 1947, 432.—A triterpene acid has been isolated from the plant *Goodenia ovata* and has been identified as ursolic acid by comparison with an authentic specimen, and by the preparation of a number of ester derivatives.

14639. **Mapstone, G. E.** Nomograph for Hydrochloric Acid. *J. Aust. Chem. Inst.*, xiv, 1947, 338.—Data for the vapour pressure of hydrochloric acid over alunite leach liquors containing aluminium chloride and free acid are presented in nomographic form.

14640. **Mapstone, G. E.** Theoretical Aspects of the Maximum Recovery in Absorption or Stripping Operation. *J. Proc. Roy. Soc. N.S.W.*, lxxxi, 1947, 84.—A general mathematical relationship based on Henry's law has been developed for the maximum transfer of (i) all components, (ii) any one component, of a multi component mixture from one phase to the other in a counter current liquid-vapour system. Since the maximum transfer calls for equilibrium terminal conditions, the system must contain an infinite number of theoretical plates. The derivation is based on the absorption of a multi-component "naphtha" from the vapour phase by counter current scrubbing with an oil that has been incompletely stripped of the "naphtha" components before entering the system. The resultant equations apply to both absorption and stripping operations.

14641. **McTaggart, F. K.** The Beneficiation of Australian Graphite by Treatment with Chlorine at High Temperatures. *J. C.S.I.R.*, xx, 1947, 409.—Flotation concentrates containing 90% carbon were chlorinated between 1250° C. and 1450° C. to give a product containing only 0·05% of ash. The influence of temperature, chlorine rate, addition of inert gas and the effect of carbon tetrachloride were determined.

14642. **McTaggart, F. K.** The Chlorination of Australian Beryl. *J. C.S.I.R.*, xx, 1947, 564.—Optimum conditions for the decomposition of beryl were determined and factors influencing the rate of reaction such as particle size, catalysts, method of briquetting and temperature were investigated. Evidence was found for the presence of combined water in the beryl. This was not eliminated at 1250° C. and prevented complete separation of $AlCl_3$ and $BeCl_2$ by fractional condensation between 200–400° C. Resublimed $BeCl_2$, condensed again at 250° C., was found to be free of $AlCl_3$. Among organic solvents acetylchloride was found to be effective in separating the two chlorides.

14643. **Mapstone, G. E.** The Colorimetric Determination of Tar Acids in Gasoline. *J. Aust. Chem. Inst.*, xv, 1948, 9.—A colorimetric method for the determination of tar acids is described. When a gasoline sample is treated with dilute ammonia and sodium hypochlorite solutions a blue colour results due to the formation of an indophenol. The test is suitable for plant control work for the determination of up to 1% of tar acid in gasoline. The sensitivity is 0·05%.

14644. **Mather, K. B.** The Spectrographic Analysis of Uranium. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 187.—The spectrographic method of analysis has been applied to uranium using graphite and copper electrodes. The spectral region from 4500–3500 Å.U. contains most of strongest and medium arc lines. From actual tests on ores, taken from the Mt. Painter deposits, it is considered that 0·1% uranium may be detected with certainty. This figure is about one-tenth the sensitivity that can be attained by chemical means and far below the Geiger Counter sensitivity.

14645. **Murphy, K. K., and Reuter, F. H.** The Laboratory Preparation of Phosgene. *J. Aust. Chem. Inst.*, xv, 1948, 144.—After consideration of the reaction between chlorine and carbon monoxide, the oxidation of chloroform with chromic acid and the reaction between carbon tetrachloride and oleum the latter is considered the most convenient. A suitable design of apparatus for kilogram scale production is given. Nine references.

14646. **Neuhaus, J. W. G., and Reuter, F. H.** Some Esters of l, Citronellic Acid. *J. Aust. Chem. Inst.*, xiv, 1947, 286.—The preparation of 16 esters of l, citronellic acid is described. The density, specific rotation and molecular refraction have been determined for each. The esters were prepared either by azeotropic distillation with benzene of the water formed by direct reaction between the acid and the alcohol or by reaction between citronellic anhydride and the alcohol.

14647. **Pilkington, E. S.** Note on Recovery of Potassium Iodate in the Iodate Method for the Determination of Thorium. *J. Aust. Chem. Inst.*, xv, 1948, 101.—The iodate waste liquors are precipitated with lead nitrate. The lead iodate is decomposed by boiling with a slight excess of potassium carbonate, and the potassium iodate recovered by evaporation.

14648. **Potter, R. S.** Ascorbic Acid in Queensland Fruits. *J. Aust. Chem. Inst.*, xiv, 1947, 290.—An examination of the vitamin C content of Queensland fruits by the metaphosphoric acid-dichlorphenol-indiphenol method, with special emphasis on losses during canning.

14649. **Ralph, C. J.** Some Minor Constituents of Eucalyptus Oils. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 208.—From large amounts of still residues (155 kg.) of oil of *E. dives* var. *C.*, the fraction b.p. 128°, 10 mm. was found to contain methyl cinnamate; the fraction b.p. 128–152° C. contained eudesmol, m.p. 79·5° C., and geranic acid, identified by transformation to alpha-cyclo-geranic acid and dihydroxy-dihydro-alpha-cyclo-geranic acid. From *E. Australiana* still residues, methylcinnamate (140 g.) and geranic acid were isolated, and from the fraction 100–120° at 9 mm. a small amount (27 g.) of a substance b.p. 264–267° C. considered to be aromadendrene. From residues of *E. dives* after removal of the piperitone with sodium bisulphite varying amounts of p-menthone-1 : 2 : 3 triol, m.p. 165° C., were obtained. The triol was identified by transformation to the ester with acetic anhydride, to p-cymene and carvotan-acetone with concentrated hydrochloric acid, and finally to alpha-isopropylglutaric acid.

dollars per annum and should be sent to the Managing Editor, G. de B. Robinson, University of Toronto, Toronto, Canada.

National Institute of Sciences of India

The National Institute of Sciences of India was founded in 1935 with the object, amongst others, of co-ordinating and encouraging scientific research in India. The Institute publishes *Proceedings* (every month), *Transactions* and *Indian Science Abstracts*. Recently this Institute has entered on a new era of greatly expanded activities. The Government of India has recognized the Institute as the premier scientific organization of the country, to be consulted in all matters connected with co-ordination and encouragement of scientific researches. The Government has also sanctioned a recurring grant for the institution of research fellowships, and a non-recurring grant for a building for the Institute in Delhi, to which the office of the Institute was transferred in 1946.

Physics of Drying in Heated Air

Experiments upon the drying of fruit and vegetables have been conducted by the D.S.I.R. in Great Britain so that more efficient machinery may be designed to replace the crude and empirical methods that have been practised for centuries. The standard test which has been used throughout is to dry the material in air moving at constant speed, at constant temperature and humidity. Results are shown as a graph of water content against time.

The investigation has been directed chiefly to the *over-draught* method of passing the air stream above a thin layer of vegetables and the *through-draught* method of passing it through a somewhat thicker layer of fruit. Other methods have also been considered in less detail, indicating means by which data from the fundamental methods may be applied to them. Effects of methods of cutting the material, of thickness of layer and of speed of air have been studied, together with resistance to flow.

The information is published in the D.S.I.R. *Food Investigation Special Report No. 53.*

Low Temperature Laboratories, Ottawa

Low temperature tests in Canada, which in the past have been possible only at field stations established as far north as transportation conditions permitted, will be made in laboratories of the National Research Council which were opened in Ottawa in May. They will be used for tests upon the starting and running of engines, the operation of hydraulic and pneumatic control systems, the development of heating systems and of insulated clothing and buildings, the shattering of plastic canopies and physiological exposure problems.

The largest of the cold chambers can accommodate a specimen 50 feet by 15 feet and 12 feet high. With a dead load of 40 tons the temperature can be lowered to minus 80° F. in 16 hours and can be held with an internal heat load of 165 kilowatts. Any desired combination of temperature, wind and chill factor can be produced and held.

Appeal from Roumania

The Polytechnic Institute (or University) of Jassy, Roumania, has issued a general appeal to scientists and scientific institutions for help in re-establishing contacts and in replacing losses of books and periodicals in their Central and Mathematical Library. The *Bulletin* of the Institute and its *Scientific Review* (the latter published in Roumanian) are offered in exchange. Communication should be made to the Director of the Central Library and of the Mathematical Department.

Ian McMaster Scholarship

The Ian McMaster Scholarship for 1948 and 1949 has been awarded to Mr. Vincent Massey, who is an honours graduate in Biochemistry of the University of Sydney. Mr. Massey will work at the McMaster Laboratory of the Council for Scientific and Industrial Research, where he will study intermediary metabolism in animal parasites. He is also making an investigation of the nutritional factors associated with resistance to helminth infections.

Organization for Scientific Research, N.E.I.

The newly established Organization for Scientific Research in the Netherlands East Indies, with functions similar to those of the C.S.I.R. in Australia, desires to establish and maintain contact with research councils, scientific institutions and other bodies interested in the co-ordination of applied and pure research in science. It would especially appreciate the receipt of reports and other publications in exchange for its own.

Communications should be directed to the Organization for Scientific Research, Koningsplein Zuid 11, Batavia, Java.

Overseas Scientific Relations, U.K.

An Interdepartmental Committee on Overseas Scientific Relations has been established to consider and advise on questions of United Kingdom Government policy. The Chairman is Sir Edward Appleton, G.B.E., K.C.B., F.R.S. In addition to representatives of Government departments, the membership will include the Foreign Secretary of the Royal Society, representatives of the British Council and of the Conference of Research Associations and two university scientists.

The Secretary is Mr .H. L. Verry, Overseas Liaison Division, D.S.I.R., 142 Piccadilly, London, W.1.

Reviews of German Science and Industry

Investigations on war-time industry and science in Germany were pursued until June, 1947, and reports were prepared by B.I.O.S.

(British Intelligence Objectives Sub-Committee), by F.I.A.T. (the American counterpart, Field Information Agency, Technical), and by their predecessor, C.I.O.S. (Combined Intelligence Objectives Sub-Committee). It is stated that 2,720 reports have been issued and more than one million copies have been distributed. Critical summaries in each of the major fields, to be known as *B.I.O.S. Overall Reports*, fifty in number, have now been issued. The first seven are upon the petroleum and synthetic oil industry, shipbuilding and marine engineering, the timber industry, the glass industry, the road system, agriculture, and the rubber industry. Inquiries should be addressed to the Board of Trade, T.I.D.U., Research Section, 40 Cadogan Square, London, S.W.1.

Reviews in the fields of pure science are being compiled by German experts under the direction of the Field Intelligence Agencies (Technical) of the British, American and French occupation and are being published under the title *FIAT Review of German Science*. It is being written in German, and an edition under German auspicés is also being published, with the title *Naturforschung und Medizin in Deutschland, 1939–1946*. It is intended that the review will contain 16 volumes of physics, 24 of chemistry, 7 of mathematics, 27 of medicine, 4 of biology and 8 of earth sciences. The first printing is a restricted edition for official distribution between the three allies and UNESCO. The British Commonwealth share of about 250 sets will be issued to governmental bodies, to universities and to certain learned and professional societies. In Australia the distribution is being handled by the Division of Industrial Development in the Ministry of Post-War Reconstruction, from whom sets may be purchased as available at approximately One Pound per volume. The German edition will be published by Dieterich'sche Verlagsbuchhandlung, Wiesbaden, and will be obtainable through normal trade channels.

The following have already appeared: *Biochemistry* (the first of three volumes, ed. Richard Kuhn); *Physics of Solids* (first of two volumes, ed. G. Joos); *Radiology* (diagnostic and therapeutic, ed. H. Holthusen); *Bacteriology and Immunology* (ed. H. Schmidt); *Virus Diseases of Man* (ed. R. Bieling and H. Heinlein); *Anatomy, Histology and Embryology* (ed. P. Stöhr).

Implementation of the Fulbright Act

Executive agreements for the implementation of the Fulbright Act were signed with the United States of America by China in November, 1947, by Burma in December, 1947, and by the Philippines in March, 1948. Similar draft agreements have been submitted to New Zealand, Belgium, Greece, Italy, Egypt, Finland, Hungary and Poland, and are in course of submission to Australia, the United Kingdom, France, Holland, Norway, Czechoslovakia, Austria, Turkey, Iran and the Netherlands Indies. Preliminary exploration has begun with regard to India and Pakistan. Educational foundations have been established in Burma and China to facilitate the administration in those countries of the programme of educational exchanges authorized by the Act.

The purposes of the Act in relation, for example, to the Philippines, are stated to include the financing of "studies, research, instruction and other educational activities of or for citizens of the United States of America in schools and institutions of higher learning located in the Philippines, or of the citizens of the Philippines in United States schools and institutions of higher learning located outside the continental United States . . . including payment for transportation, tuition, maintenance and other expenses incident to scholastic activities; or furnishing transportation for citizens of the Philippines who desire to attend United States schools and institutions of higher learning in the continental United States . . . whose attendance will not deprive citizens of the United States of America of an opportunity to attend such schools and institutions".

The agreements thus provide for transportation of students, research workers and educators from other countries to the United States, provided that they have already been accepted by institutions there and that their other necessary funds are assured from other sources.

Basic policies and mechanisms to guide the exchange programme have been developed by the Board of Foreign Scholarships which was appointed under the Act in July, 1947. Applications for grants for students are received and screened by the Institute of International Education. Applications from school teachers are received and screened by the U.S. Office of Education; those from teachers at tertiary level and from research workers by the Conference Board of Associated Research Councils, whose address is 2101 Constitution Avenue, Washington, D.C., U.S.A.

The first award under the Act was made in March to Dr. Derk Bodde, sinologist of the University of Pennsylvania, who will engage in research leading to the annotation and translation of a particular Chinese classic.

Personal

Dr. H. G. Raggatt, Director, and Dr. N. H. Fisher, Chief Geologist, of the Bureau of Mineral Resources, have been attending the eighteenth International Geological Congress in London. Mr. J. M. Rayner, Chief Geophysicist, is at present abroad in connection with the selection and purchase of scientific equipment.

Dr. I. W. Wark, Chief, Division of Industrial Chemistry, C.S.I.R., is at present visiting Great Britain and the U.S.A. to see research institutions. He is enquiring especially into advances in surface chemistry. Dr. Wark is expected to return at the end of October.

Dr. I. V. Newman has been appointed Professor of Botany at the University of Ceylon. Professor Newman was formerly a Linnean Macleay Fellow and was recently at Victoria University College, Auckland.

Mr. D. J. Lee has been appointed lecturer in Medical Entomology at the School of Public Health and Tropical Medicine, Sydney.

National University Research Scholarships

The Australian National University has announced the appointment of twenty-seven research scholars, as shown below, in the fields of physical sciences, medicine, social sciences and Pacific studies. The appointments are made in furtherance of the University's policy to develop as rapidly as possible by preparing research workers for the time when it will itself have suitable buildings and equipment available. The trained scholars should also help to fill the urgent future needs of other Australian universities and institutions. They will study under the supervision of academic authorities, mostly in Great Britain, in branches of research related to the immediate interests of the National University. There were over a hundred applicants and the large number appointed reflects the conditions which have resulted from the lack of opportunity for experience in pure research abroad during the war. All have had research experience within Australia.

J. A. Allen, University of Queensland.
I. R. C. Bick, of Queensland, at present at Cambridge.
S. T. Butler, University of Adelaide.
J. O. Cope, University of Melbourne.
S. F. Cox, of Canberra, at present at the Royal College of Science, London.
F. K. Crowley, University of Melbourne.
D. F. Crozier (Miss), University of Melbourne.
C. Culvenor, University of Melbourne.
M. H. Draper (Dr.), University of Adelaide.
R. A. Gollan, Sydney Teachers' College.
C. P. Haddon-Cave, University of Melbourne.
M. Holmes (Miss), University of Melbourne.
P. G. Klemens, University of Sydney.
C. C. Kratzing, Australian Institute of Anatomy, Canberra.
P. Lawrence, of New South Wales, now at Cambridge.
J. D. Legge, University of Western Australia.
J. F. McCrea, Walter and Eliza Hall Institute, University of Melbourne.
G. B. Mackaness (Dr.), of Sydney, at present at the British Postgraduate Medical School, London.
D. B. Morell, Australian Institute of Anatomy, Canberra.
W. L. Morison, University of Sydney.
K. E. Read, of New South Wales, now at the London School of Economics.
R. V. Sellwood (Dr.), University of Queensland.
L. N. Short, Wollongong Technical College.
G. R. Storry, formerly of the Colonial Office, London.
C. J. Stratmann, University of Melbourne.
P. B. Treacey, University of Sydney.

The Solar Eclipse of 1 November, 1948

A total eclipse of the sun will occur on 1 November. The total phase will begin at sunrise in Central Africa a little north of the equator and pass Entebbe, Kisumu and Nairobi; thence north of Madagascar to cross the Indian Ocean tending towards the south to latitude 49 degrees. The path of the total phase passes about 300 miles south of Tasmania and ends before reaching New Zealand. The duration of totality on the African continent is a little less than a minute at the most and reaches 1m. 55·8s. over the Indian Ocean. In Australia the phenomenon will be a partial eclipse except in the northernmost parts. Beginning and ending of eclipse, reckoned in the appropriate standard times in each case, are respectively 2h. 03m. and 4h. 21m. p.m. at Perth; 4h. 07m. and 6h. 07m. p.m. at Adelaide; 4h. 39m. and 6h. 38m. p.m. at Melbourne. In Sydney the eclipse begins at 4h. 47m., in Wellington at 6h. 12m. p.m., standard time, ending after sunset in both cities. The magnitude of the eclipse at the five cities, in the order stated, is 0·49, 0·59, 0·72, 0·63 and (at sunset) 0·35, respectively.

Acta Allergologica

A new periodical, *Acta Allergologica*, is to be published by the Northern Society for Allergological Research. Original research work in the field of allergy will be printed in English, French or German at the choice of the author. The journal will appear at irregular intervals, generally one or two volumes a year, each volume being comprised of four numbers of about eighty pages each.

Contributed articles should be sent to the Editor-in-Chief, Ernst B. Salén, Stockholm. Subscriptions, at 35 Danish kroner per volume, should be sent to Einar Munksgaard, Nørregade 6, Copenhagen, Denmark, or through usual trade channels.

System of Categories of Natural Science

In an address delivered to the Geological Section of the Royal Society of New South Wales on 23 July, 1948, Dr. Leo F. Koch described a new type of Schedules for geological and mineralogical investigations, based upon the System of Categories of Natural Science. A system has been developed similar to Aristotle's Table of Categories, but worked out as the *System of the Ultimate Modes of Being of Natural Units as Perceived through the Senses.* The highest principles of division and grouping of the new system of categories are the forms of apprehension, space and time. The system is called TETRAKTYS, because of the fourfold, partly tetrahedral, configuration of its parts and elements.

When the whole content of the *Schedule for the Field Description of Sedimentary Rocks** is projected on to forms showing the pattern of the Tetraktys—facts belonging to petrography, mineralogy, palaeontology, etc., being projected separately—then approximately half of the categories or categorical concepts of the Tetraktys are covered by corresponding elements of the *Schedule* mentioned above. The *System of Categories of Natural Science*, therefore, when applied to objects of the geological sciences, shows the totality of the categories of the geological field observations possible by means of the unaided senses. The system can likewise be used for checking the completeness of any other geological *Schedule* as well as any description of geological or mineralogical features.

The International Unions

Commission on Macromolecular Chemistry

This Commission of the International Union of Chemistry met in Liège in April. It was suggested that similar commissions might be formed in the Unions of Physics, Biological Sciences and Crystallography, rather than a mixed commission of all four. Type samples of polystyrene, polyisobutylene and cellulose acetate are being distributed to laboratories in order to compare methods of determining macromolecular weights. The Technical Association of the Pulp and Paper Industry has suggested a method for measuring the viscosity of cellulose in solutions of cupri-ethylene-diamine, which apparently gives results much superior to the classical method, which uses solutions of ammoniacal copper hydroxide.

The meeting of the Commission was followed by a Colloquium on Large Molecules, at which the chief topics were: the macromolecular chemistry and structure of coals; the structure of macromolecular chains; the reactions of polymerization; the phenomena of hydration and crystallization of cellulose derivatives; the study of macromolecules by infra-red spectrography; and isomerism in macromolecules.

International Union of Chemistry

The fifteenth General Conference is to be held at Amsterdam, 6–10 September, 1949. The President is Dr. Sieger, the Director of the N.V. Amsterdamsche Chininefabriek.

The sixteenth Conference is to be held at New York and Washington in 1951, following the Assembly of the American Chemical Society which is planned for 2–7 September, 1951, in New York. The Conference sessions are to be on 8 and 9 September in New York and 15–17 September in Washington. The twelfth Congress of Chemistry Pure and Applied will be held in New York from 10 to 14 September, 1951, under the presidency of Professor J. B. Conant. A grant of 200 dollars will be made to 500 delegates to the Congress. Nations in classes A, B and C will be entitled to 27, 18 and 9 delegates respectively. Australia's membership of the Union is in class B and its delegates will be nominated by the Australian National Research Council in the rôle of adhering body.

International Union of the History of Science.

The Commission on Bibliography met in London in March and considered various proposed projects. One of these was for a series of studies on militant faith in human reason among men of science at critical epochs. Another was for co-operation in the production of a mediaeval Latin dictionary. It was decided to take steps towards the extension and publication of the hand-list of scientific manuscripts written before the year 1500, compiled by the chairman, Mrs. D. Waley Singer. The list, which is drawn from Great Britain and Ireland only, comprises over 250,000 cards, in 37 sections. Of these, the Alchemy Section has already been published, in four volumes, and the Pestilence Section is in 1,890 pages of typescript ready for publication. The Astronomy, Mathematics and Medicine Sections will now receive first consideration. Endeavours will be made to find young scholars who would be prepared to give a year or two to extending one or other of the Sections to European countries. As regards oriental texts, Dr. Stapleton is well advanced in cataloguing the important Arabic manuscripts in the libraries of India.

At a further meeting in Paris in May the Bibliography Commission arranged to compile a list of the most important texts in world development of science, for transmission to UNESCO as a basis for collecting the classics of science. A priority list of scientific translations is also to be compiled.

The Commission on the Teaching of the History of Science met in Paris in May, under the presidency of Professor A. Reymond, of Lausanne. A preliminary survey of the teaching of science in eight countries showed that it still lacks organization. The survey is to be intensified and is to be extended to all countries. It is hoped that chairs in the History of Science will be established in important universities. A book is to be prepared upon the importance, rôle, aims and methods of science teaching.

The Commission on Publications met in Paris in May under the presidency of Professor Charles Singer, of London. It arranged for collaboration with the International Academy of the History of Science, so that it would referee suggestions for publications by the latter body. The Council of the Academy later met under the presidency of Professor P. Sergescu, of Bucharest. The official publication of the Academy will be entitled *Les Archives Internationales d'Histoire des Sciences* and will comprise about 800 pages a year.

The Council of the Union, with Professor Charles Singer as President, met in Paris

* *Bull. Amer. Assoc. Petroleum Geologists* (1922), 6, 254-9.

after the meetings of its Commissions. Five further countries were admitted—Argentina, Italy, Luxemburg, Holland and Uruguay—which when added to the existing members—Great Britain, France, Palestine, Roumania, Czechoslovakia, Belgium, Brazil, Portugal and Switzerland—make a total of fourteen adherents. Approaches towards membership have also been made by South Africa, Egypt, Hungary, India, Peru, Poland and the United States.

The Night Sky in September and October

New Moon occurs on September 3d. 21h. 21m. and on October 3d. 05h. 42m.; Full Moon occurs on September 18d. 19h. 43m. and on October 18d. 12h. 23m., Eastern Australian Time. Venus is a morning star, in the constellations of Gemini, Cancer, Leo and Virgo successively, with magntude –4·0 to –3·6. It passes 0·4 degrees south of Regulus on October 5 and 1·1 degrees south of Saturn on 8 October. Mars is an evening star, in the constellations Virgo, Libra, and Scorpio, in the west in the early evening, of magnitude 1·5. Jupiter is an evening star in the constellation Ophiuchus, of magnitude –1·7, 6 hours behind the Sun on 10 September and 3 hours behind the Sun on 3 November. Early in September, Saturn is close to the Sun, but soon becomes a morning star and is 4 hours ahead of the Sun by 28 October; its magnitude is 0·9. Mercury is an evening star in September, being about an hour behind the Sun at the beginning of the month and 1½ hours behind the Sun at the end of the month; but it passes the Sun on 19 October, when at its nearest to the earth.

On 31 October there is a daylight occultation of Mercury, magnitude 0·2, by the Moon; the time of disappearance at Sydney is 8h. 31·8m. and of reappearance 9h. 40·2m. a.m., Eastern Australian Time. At the end of September the axis of the Southern Cross lies approximately horizontal at 6 p.m. and is at its lowest, near or below the horizon due south, at midnight.

The Universities

University of Sydney

The Senate has accepted the following gifts: £100 from Mr. A. M. Cohen, for research into treatment of rheumatoid arthritis; the Charles E. Fawsitt Prize Fund of £184, for a prize in Chemistry I; two prizes of seven and a half guineas each from the Australian Chemical Institute, for students graduating in the two branches of chemistry; a grant of £1,400 from the McGarvie Smith Institute, for the erection of a temporary animal hospital at the Animal Husbandry Farm of the University.

Mr. D. Winston, borough architect and general planning officer at Southampton, England, has been appointed as the first occupant of the Chair of Town and Country Planning. Mr. R. J. Swaby, of Melbourne, has been appointed as Senior Lecturer in General Bacteriology, and Mr. B. R. A. O'Brien as Lecturer in Experimental Embryology. Professor R. M. C. Gunn, of the Department of Veterinary Anatomy and Surgery, has gone abroad on leave to attend the International Congress on Animal Reproduction and other conferences.

Emeritus Professor David Arthur Welsh died on 13 May, 1948, at the age of 82 years, after a long illness. He was the first Professor of Pathology in the University and occupied the chair from 1902 to 1936. His research work included a study of the parathyroid glands, experiments with precipitins, investigation of blood parasites, and numerous papers with regard to cancer. In the many years in which he was responsible for the pathological work of the Royal Prince Alfred Hospital he did much to stimulate interest in clinical pathology. Professor Welsh came to Sydney from Edinburgh; he was a most competent and interesting teacher and attracted a staff of high calibre. He took an exceptional interest in individual students in practical classes.

University of Queensland

It is proposed to establish a scholarship in Engineering as a memorial to the late Professor R. W. H. Hawken, to be awarded by the Senate of the University of Queensland. Contributions should be made by cheque payable to the *R. W. H. Hawken Memorial Fund* and are subject to taxation rebate.

The pathology museum in the Medical School is to be named the *James Vincent Duhig Museum of Pathology*, in recognition of the services rendered by Dr. Duhig as Honorary Professor from 1938 to 1947, in establishing and organizing the Pathology and Bacteriology Department.

University of Melbourne

The following appointments have been made: Professor Benjamin Higgins, of McGill University, Montreal, as Ritchie Research Professor of Economics, following Professor L. F. Giblin; Dr. J. W. Johnstone as Acting Professor of Gynaecology; E. J. C. Rennie as Acting Professor of Mechanical Engineering; C. E. Moorhouse, formerly senior lecturer in Electrical Engineering, to be the first occupant of the newly created chair in Electrical Engineering; Dr. G. M. Harris as senior lecturer in Physical Chemistry; Dr. H. Schwerdfeger as senior lecturer in Mathematics; A. S. Buchanan as lecturer in Physical Chemistry; Miss E. L. Mollison as lecturer in Zoology at Mildura Branch; Miss J. L. Alexander as lecturer in Chemistry at Mildura Branch; Dr. R. M. Bowden as Stewart Lecturer in Pathology; H. Maddox as lecturer in Psychology; N. H. Rosenthal as Director of Visual Aids, with the status of Associate Professor; G. Buchdahl as lecturer in General Science; Miss R. Sugden, as lecturer in Chemistry; Miss E. Nelson and Miss N. Allen

as lecturers in Physics; Dr. Michael M. Wilson, of the Department of Pathology, Cambridge, as Assistant Director of the Public Health Laboratory in the Department of Bacteriology.

The title of Professor Emeritus has been conferred upon Professor W. E. Agar, who is continuing temporarily as a lecturer in the Department of Zoology, with Professor O. W. Tiegs. To commemorate the services rendered to medicine in Australia by Dr. C. H. Mollison, it is proposed to establish a Crawford Mollison Prize, of one hundred guineas, to be awarded triennally, for notable contribution to pathology. Sir Alan Newton, the Stewart Lecturer in Surgery, has been appointed President of the Walter and Eliza Hall Institute of Medical Research in succession to Mr. Russell Grimwade. Mr. P. G. Law, lecturer in Physics, who has been making cosmic ray observations with the *Wyatt Earp* in the Antarctic, is continuing observations with the H.M.A.S. *Duntroon* in Japanese waters.

University of Adelaide

Following donations from mining companies, the University is to establish a Chair of Economic and Mining Geology.

University of Western Australia

Mr. E. W. Gillett has been elected as Chancellor in succession to Professor Walter Murdoch. Mr. A. J. Reid, the Under-Treasurer of Western Australia, succeeds Mr. Gillett as Pro-Chancellor. Dr. Horace Waring, of Birmingham, has been appointed as Professor of Biology. He succeeds Professor G. E. Nicholls, whose title was Professor of Zoology.

The Scientific Societies

Royal Society of Tasmania.

June: C. D. Hardie—Science and perception.

July: K. M. Dallas—The political economy of Van Diemen's Land.

Royal Society of New South Wales.

July: J. A. Dulhunty—Presidential Address: Some new horizons in coal utilization and research.

R. M. Gascoigne and K. G. O'Brien—Aspects of the Diels-Alder reaction. III: A note on the reported reaction with anthraquinone.

G. D. Osborne—Contributions to the study of the Marulan Batholith. I: The contaminated granodiorites of South Marulan and Marulan Creek.

G. E. Mapstone—Nitrogen in oil shale and shale oil. V: The determination of nitrogen in shale oil and oil shale. VI: Acid washing of crude shale oil. VII: Distribution of kerogen on carbonization.

July: Clarke Memorial Lecture—Sir Douglas Mawson, The sedimentary succession of the Bibliando Dome: Record of a prolonged Proterozoic ice age.

August: R. C. L. Bosworth—The incomplete nature of the symmetry relations between thermodynamical quantities.

Royal Society of Victoria.

July: E. D. Gill—Palaeozoology and taxonomy of some Australian homalonitid trilobites.

O. P. Singleton—Geology and petrology of the Tooborac district, Victoria.

Medical Sciences Club of South Australia.

June: H. M. Ferres—The statistical analysis of biological and medical data.

M. Freeman—Liver function tests.

July: P. A. Trudinger—Carotene metabolism.

M. H. Draper—Voltage changes and nervous activity.

Sydney Technical College Chemical Society.

July: R. K. Newman—Ships, cargoes and chemistry.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

The Response of the Growth of Pastures to Temperature

It has generally been accepted that Van't Hoff's rule relating the change in velocity of a chemical reaction to rising temperatures can be applied within limits to biological processes. The rule is that the velocity of a reaction is increased two- to three-fold for each ten-degree rise in temperature on the Centigrade scale.

The growth rate of an annual crop is subject to variations inherent in the development of the plant itself; even in perennial pastures individual species have their so-called zenith period of growth.

Some records of perennial pastures exist which, however, lend themselves to appropriate statistical analysis owing to the fact that the pastures have been cut at regular monthly intervals over periods of several months during which, because of adequate rainfall or irrigation, growth was not limited through lack of soil moisture. Examples have been selected from the work of Richardson and Gallus (1932) and of Schofield (1944), in which accurate temperature records were kept during the actual observations on the pastures; in the first case at Woods Point, South Australia, and in the second at South Johnstone, North Queensland.

The South Australian pastures consisted primarily of perennial rye grass with red, white and alsike clovers, and in North Queensland they consisted of perennial tropical grasses. In this latter case, for the purpose of statistical analysis, the mean growth of seven species has been taken and the yields recalculated to 28-day periods.

Certain data have been omitted—one observation at South Johnstone when soil moisture was definitely limiting and certain observations during the zenith period at Woods Point.

The Van't Hoff rule implies that a linear regression is to be expected between the

logarithm of the yield and the temperature during the period of growth. In the most perfect example tested at Woods Point a correlation coefficient of 0·986 was found for such a regression.

The regression coefficient itself can be used as a measure of the Van't Hoff coefficient of the relative increase in yield for a rise in temperature of 18 degrees Fahrenheit.

In Table I are given some of the results obtained. At Woods Point three examples have been examined. One is for pasture, mown, not grazed, without taking into account special periods of growth. The second example is for grazed pastures omitting six cuts during the zenith period, and the third for the same pasture omitting only one such yield for the September-October period.

TABLE I

Relationship between the growth of pastures and mean temperature, moisture supply being adequate. Pastures were cut at intervals of 28 days. The regressions are of the logarithm of yield on the temperature

Observers	Temperature Range ° F.	No. of Observations	Correlation Coefficient	Regression Coefficient	Van't Hoff Constant
Richardson and Gallus (1) ..	46–67	11	0·986	0·0313	3·66
(2) ..	46–68	16	0·888	0·0257	2·90
(3) ..	46–68	13	0·686	0·0199	2·28
Schofield	67–80	11	[illegible]	0·0318	[illegible]

(1) Grazed pastures omitting all data for zenith growth period.
(2) Grazed pastures omitting one observation only.
(3) Mown pastures not grazed.

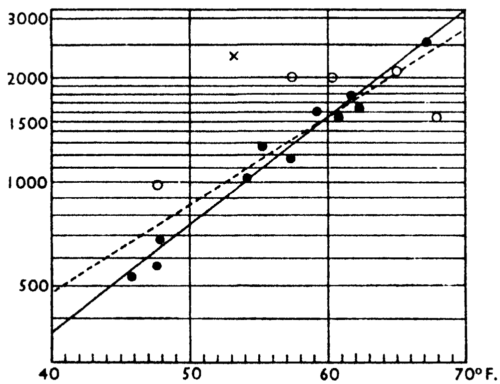

Fig. 1.
Illustrating the correlation between the yield of an irrigated pasture at 28-day interval in pounds per acre of dry matter and the mean temperature for the same period at Woods Point, South Australia. The yields are plotted on a logarithmic scale. The black circles exclude data for the zenith-growth period, which are indicated by the open circles. The continuous line gives the regression for the black circles, the broken line for all observations excluding the September-October yield indicated by a cross. Based on the data of Richardson and Gallus.

The data for Woods Point are also illustrated in Fig. 1.

All the correlation coefficients are significant at the one per cent. level or better. It is seen that between temperatures of 46°F. and 80°F. the range of values for the Van't Hoff constant is from 2·3 to 3·7; that is, the yield of a pasture may be expected to increase in these proportions for each 18°F. rise in temperature, provided that soil moisture conditions remain favourable.

J. A. PRESCOTT.
Waite Agricultural Research Institute,
Adelaide, South Australia.
24 May, 1948.

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RICHARDSON, A. E. V., and GALLUS, H. P. C. (1932): *Counc. Sci. Ind. Res. Bull.* 71.
SCHOFIELD, J. L. (1944): *Queensland Jour. Agr. Sci.*, 1, No. 4, 1-58.

A Survey of Properties of Binoculars

During the reconditioning of binoculars in the Physics Department of the University of Sydney in the war period, a survey was made of the optical properties of the different instruments encountered. Measurements were made on approximately three hundred and fifty prismatic and one hundred Galilean varieties of instruments of known makes and models. These included the modern British and American service binoculars and peace-time and first-world-war British, American, German, French, Italian and Japanese instruments. A similar number of varieties of unknown origin was also examined without disclosing anything new or unusual in properties or design.

From the detailed records of the measurements made on the instruments of known origin Table I has been compiled for the information of those interested in binocular and small telescope design. An attempt has been made to show from this cross-section of recognized designs the most frequently chosen values for the fundamental properties, such as apparent field of view, position of the exit pupil, stereoscopic power, etc., and the order of the extreme values encountered. For example, it will be seen from the table that the apparent field of view lies within a range of approximately 30° to 80°, but that over eighty per cent. of the instruments have values between 40° and 65°, the various columns in the table indicating the values for instruments

TABLE I
Ranges of Binocular Properties

Property	Max. Value	Intermediary Values 0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9	Min. Value
Prismatic Type											
Apparent field of view	81° 24′	64° 09′	53° 03′	50° 53′	50° 02′	48° 33′	46° 48′	43° 46′	41° 50′	40° 14′	30° 46′
Magnification ..	22·77	8·16	8·00	7·75	7·58	7·14	6·76	6·06	5·95	5·88	4·00
Field of view ..	11° 13′	8° 38′	8° 23′	7° 51′	7° 12′	6° 56′	6° 36′	6° 17′	6° 05′	5° 28′	1° 39′
Stereoscopic power	44·4	15·9	15·3	14·8	14·3	13·4	12·1	11·7	11·2	10·6	5·3
Diameter of entrance pupil	55·3 mm.	37·9	29·6	28·7	26·8	25·0	23·6	22·9	21·7	20·0	16·1
Diameter of exit pupil	7·70 mm.	5·00	4·70	4·02	3·80	3·62	3·42	3·12	2·98	2·78	1·42
Distance of exit pupil from eyelens ..	21·1 mm.	14·3	13·35	12·65	12·1	11·75	11·1	10·55	10·0	9·0	2·6
Galilean Type											
Magnification ..	6·0	6·0	5·4	5·2	4·7	4·6	4·5	4·3	4·2	4·1	3·4
Length of telescope	171·9 mm.	143·1	136·1	132·2	127·8	122·9	118·4	114·9	96·9	91·1	75·1
Diameter of entrance pupil	64·7 mm.	52·7	50·6	50·0	45·0	44·7	44·0	43·6	40·0	39·0	37·7
Diameter of exit pupil	19·0 mm.	12·4	11·6	10·8	10·1	9·8	9·4	8·9	8·5	6·6	6·3
Distance of exit pupil from eyelens ..	37·3 mm.	32·3	31·0	30·0	28·8	27·4	26·2	23·8	20·2	15·3	13·7
Aperture of eyelens	26·9 mm.	20·9	19·2	17·8	16·5	16·0	15·2	14·8	13·8	12·8	10·8

taken at intervals of ten per cent. of the total number of varieties examined. It should be noted that the prismatic instruments treated are those of the standard variety, which have their erecting prisms internally positioned, and do not include the larger binocular telescopes, such as the stereoscopic telescopes, in which the first reflecting prism is located outside the objective. The stereoscopic power is stated for an inter-ocular separation of 63 mm.

G. A. HARLE.

Department of Physics,
University of Sydney,
13 June, 1948.

Alkaloids in Queensland Cryptocarya Spp.

In the course of field surveys undertaken by the Drug Plants Section, C.S.I.R. Division of Plant Industry, to discover plants of chemical and pharmacological interest in the native flora, the rain-forest tree *Cryptocarya pleurosperma* White and Francis (Lauraceae) was found to contain substantial amounts of alkaloids when tested at Boonjie, North Queensland, in August, 1945.

Bancroft (1887) had already noted the presence of active alkaloids in the genus *Cryptocarya*, while Maiden (1895) had commented on the significance of Bancroft's findings for future chemical investigations.

The first bulk sample of bark and leaves for chemical analysis by southern workers co-operating in the Drug Plants Survey was collected at Boonjie in October, 1945. No untoward effects were noticed by any of the collectors at that time, although it was raining heavily and the water may have removed traces of any active principle from the hands.

Subsequently a larger sample of bark was collected by Mr. Les. Wright of Mareeba. Mr. Wright's hands came in contact with the sap and inner surface of the bark and within twenty-four hours he noticed that an "itchy rash", with reddening, appeared on the backs of his hands and wrists and round his mouth.

He attributed the latter to the fact that he had touched his lips with his hands. The irritation and eventual blistering persisted for about two weeks, during which time Mr. Wright suffered a certain amount of discomfort, although he continued work. The lesions gradually healed, leaving scars which were visible two years later.

Laboratory workers suffered skin irritation and blistering as a result of handling the milled bark samples. These effects, together with an account of the isolation of two alkaloids and their preliminary chemistry and pharmocology, were noted recently by de la Lande (1948). The active alkaloid was termed "cryptopleurine" and is extremely toxic.

There are some twenty-two species of *Cryptocarya* in Australia. They are mainly trees, found in the rain-forest, and several are cut commercially for timbers. Alkaloid spot-tests, the methods for which are described by Webb (*C.S.I.R. Bulletin*, in press) have indicated that fifteen species out of nineteen tested probably contain appreciable amounts of alkaloids. In no case other than *C. pleurosperma* has the writer observed blistering or dermatitis to be caused by contact of the skin with the bark of these species. Further, no other local species in the Lauraceae is reputed popularly to cause skin irritation. *C. australis* Benth. is the only Australian species of *Cryptocarya* which is very close to *C. pleurosperma* from a botanical point of view, according to Mr. C. T. White, Government Botanist of Queensland. In New Guinea the new genus *Pseudocryptocarya* is also very close botanically to *C. pleurosperma*. A number of the Queensland *Cryptocarya* spp. are now under examination in the chemical and physiological laboratories of eastern Australian universities, which are collaborating with C.S.I.R. in the Drug Plants Survey.

Although we have no records of alkaloids with a vesicant action similar to cryptopleurine, it is interesting to note that chloroxylonine $C_{22}H_{23}O_7N$ from the wood of the East Indian Satinwood (*Chloroxylon swietenia* DC.) is a powerful skin irritant (Cash, 1911). No representative of this family (Rutaceae) in Queensland is recorded as causing dermatitis.

A number of Australian plants has the popular reputation of causing dermatitis, which is a frequent discomfort to timber-cutters, sawmillers, and other workers with forest products. It is possible that the investigations now in progress in the Drug Plants Survey may eventually discover specific causal agents, including resins, oils, saponins and alkaloids.

L. J. WEBB.

Drug Plants Section,
Division of Plant Industry, C.S.I.R.,
Brisbane, Queensland.
15 June, 1948.

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CASH, J. T. (1911): *Brit. Med. J.*, 784-790.
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MAIDEN, J. H. (1895): *Rept. Aust. Ass. Adv. Sci.*, 6, 25-57.

Inhibition of Vaccinia Haemagglutination by Protamine and Histones

It has previously been reported (Fisher, 1948) that the ether- and acetone-soluble fraction of the lipoids of the stroma of human erythrocytes inhibits in high dilutions the haemagglutinin of Haemophilus pertussis, and that the same fraction contains a substance which itself agglutinates the erythrocytes of some fowls. The pertussis haemagglutinin inhibitor and the fowl cell agglutinin of this fraction are not identical; the latter is selectively neutralized by albumen and it deteriorates more rapidly. However, there may be close chemical relationship between the two substances, as judged by their identical distribution in differential fat solvents. The fowls whose erythrocytes are agglutinated by human erythrocyte stroma lipoids are the same as those whose cells are susceptible to agglutination by lipid extracts of various tissues and by suspensions of vaccinia virus, as reported by Burnet and Stone (1946).

It has long been known that solutions of basic proteins agglutinate erythrocytes (for references see Landsteiner, 1946), and haemagglutination has been obtained in this laboratory with protamine from fish sperm and with histones from thymus and from fowl erythrocyte nuclei. These substances showed activity in dilutions of about 1 in 500,000 against 0·5% fowl erythrocytes.

It has been noted that when mixtures of appropriate dilutions of protamine and suspensions of fowl cell agglutinin from human erythrocyte lipoids were tested against susceptible fowl erythrocytes mutual neutralization of the two haemagglutinins occurred and the test cells settled out without being agglutinated. The neutralization obeyed the law of constant proportions; if either of the reagents was in excess, haemagglutination resulted.

Agglutination of "Susceptible" Erythrocytes in a Mixture of Neutral Protamine Solution with Vaccinia Suspension.

No. of Haemagglutinating Doses of Vaccinia	No. of Haemagglutinating Doses of Protamine					
	32	16	8	4	2	1
32	±	Tr	±	+	+	+
16	+	±	±	+	+	+
8	+	±	−	Tr	+	+
4	+	+	−	−	+	+
2	+	+	+	±	Tr	Tr
1	+	+	+	+	Tr	−

+ = complete agglutination.
± = partial agglutination.
Tr = trace of agglutination.
− = no agglutination.

Similar neutralization occurred in mixtures of protamine solution with suspensions of vaccinia virus, and when protamine was replaced by histone from thymus or fowl erythrocyte nuclei.

The simplest explanation of this phenomenon is that protamines and histones combine with vaccinia haemagglutinin, preventing its attachment to the erythrocyte surface and vice versa. It seems, therefore, not improbable that the receptor for vaccinia virus on the surface of susceptible fowl erythrocytes is a basic protein.

The observation that protamine and histone combine with vaccinia virus provides a possible explanation of the fact that protamines and histones inhibit the production by vaccinia virus of lesions in the rabbit dermis (McClean, 1930).

STEPHEN FISHER.
Commonwealth Serum Laboratories,
Parkville, Melbourne,
17 June, 1948.

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FISHER, S. (1948): To be published.
LANDSTEINER, K. (1946): The Specificity of Serological Reactions (revised edition). Harvard University Press.
McCLEAN, D. (1930): *J. Path. and Bact.*, *33*, 1045.

The Adhesion of Limpets

The tenacity with which a limpet clings to its substratum is proverbial, but the mechanism by which it attaches itself and the force which is necessary to remove it from the rock whereon it lives are less well known. Hamilton (1892) states that a shell-less specimen of *Patella vulgata* can hold about 1,984 times its own weight in air and about double that when immersed in water. Aubin (1892), working with the same species records an average pull (from 20 specimens tested) of about 8·29 lbs. per sq. cm. with variations between 5·75 and 11·03 lbs. per sq. cm. Menke (1911) records an average (from 12 specimens tested) of 4·37 lbs. per sq. cm. with variations between 1·35 and 8·33 lbs. per sq. cm. Loppens (1922) found that a force of 15 Kgm. was necessary to remove an adult specimen of *P. vulgata*, but he did not specify its size further.

As to the mechanism of attachment, Woodward (1875) observes that "they adhere very firmly by atmospheric pressure (15 lb. to the square inch)", but the figures of Aubin and Menke given above and those obtained in the present investigation show that in most cases forces very much greater than this are needed to detach them. Aubin states that the film of mucus under the foot "is too thin to have much cohesion" so that adhesion by this means is unlikely to be a major contributing factor in the fixation of the mollusc. Davis (1895) and Davis and Fleure (1903) from their observations, experimental and anatomical, also abandon the "suction" theory and the idea of adhesion by a glutinous substance and come to the conclusion that it is "in fact . . . a case of adhesion like that between two smooth glass surfaces brought very close together. The muscular foot is, so to speak, rolled out on the rock with which it is thus brought into very close contact."

The present investigation on some 200 specimens of *Cellana tramoseica* Sowerby seems to indicate that three factors are involved in adhesion: (*a*) a secretion by the unicellular glands of the sole and margins of the foot; (*b*) the musculature of the foot; and (*c*) the blood system, which by tensely filling the blood spaces of the foot makes it fairly rigid. This last factor, however, is not believed to be of major importance.

The sole and foot margin secrete a highly viscous, mucilaginous fluid which is sticky to the touch in a freshly removed limpet and with this the animal can hold its own weight on the under surface of a sheet of glass when only half or less of the foot is in contact with it. If the sole is touched with a moistened finger, the adhesiveness is not so apparent. A similar adhesiveness can be noted on the rock with which the foot was in contact. The importance of this secretion lies in its forming an air- (or water-) tight seal between the sole and the underlying rock. When force is applied to draw the animal away from a rock in a direction at right angles to its plane, the high viscosity and tensile strength of this secretion resist the ingress of air (or water) between the foot and the rock, so that the animal remains attached until the force exerted (*a*) becomes sufficient to overcome this viscosity or (*b*) is maintained for a sufficiently long time for the fluid to retract between the sole and the rock and allow the ambient medium to enter. In either case the animal becomes detached.

Experimental results on *C. tramoserica* in its natural habitat show that when an upward tension is applied to the animal quickly, forces of up to four or five times the magnitude of those which would be required by no more than atmospheric pressure (at 2·32 lbs. per sq. cm.) are needed to remove it, but much smaller tensions, only slightly above atmospheric pressure maintained for a considerable time (15 minutes or more) will, however, bring the animal away.

That muscular activity enters into the problem is readily observed when a resting animal is disturbed. It immediately clamps down on to the rock face and becomes much more difficult to remove. Furthermore, when a limpet is subjected to a steady pull for some time the shell can be seen to lift slightly shortly before it comes away from the rock as the muscles relax in fatigue. The foot then does not function merely as a sucker, but its musculature maintains it in a rigid condition, blood pressure assisting to some extent herein. Parker (1921) has shown that the suckers of

an octopus cannot resist a pull of more than 70% of that which would be expected from atmospheric pressure, so the mechanism here is quite different from that found in the limpet. Adhesion in the octopus is by suction pure and simple, while in the limpet the viscosity of the foot secretions is of major importance.

It is hoped to publish these and further results elsewhere shortly.

I. M. Thomas.

Department of Zoology,
University of Adelaide,
16 June, 1948.

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Menke, H. (1911): *Zool. Anz.*, *37*, 19-30.
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The Occurrence of a Physiological Form of Eucalyptus citriodora Hooker

The essential oil present in the leaves of *Eucalyptus citriodora* Hooker, has been produced on a commercial scale by steam distillation for over fifty years. During that period many thousands of gallons have been marketed. The principal constituent of the oil is the aliphatic aldehyde citronellal, which is present to the extent of 65% to 85%.

Recently, whilst conducting a survey, we have examined the oil from individual trees which contained only a small quantity of the aldehyde citronellal. The principal constituents are the corresponding alcohol citronellol and its esters. The physical and chemical characters of this oil, together with those of a typical oil, are as follows:

	E. citriodora, Type.	*E. citriodora*, Citronellol Form.
Specific gravity 15/15°	0·8607 to 0·874	0·8898
Refractive Index 20°	1·4498 to 1·4575	1·4580
Optical rotation ..	−0·2° to +1·5°	+2·7°
Citronellal content .	65% to 85%	7%

This observation is of great scientific and technical interest. It reveals, for the first time, a physiological form of *E. citriodora*, a species previously noted for the constancy of its characters; in fact Baker and Smith (1920) stress the stability of the species and the constancy of its essential oil, irrespective of its place of growth.

Penfold and Morrison (1927), who first showed the occurrence of physiological forms in the essential oil-yielding plants of Australia, notably the Eucalypts, apply the term to those plants which cannot be separated on morphological evidence, but which are readily distinguished by marked differences in the chemical composition of the essential oils.

Results of the complete examination of the oil, now in progress, will be published in the *Journal of the Royal Society of New South Wales.*

A. R. Penfold.
F. R. Morrison.

The Museum of Technology and
Applied Science,
Sydney,
23 July, 1948.

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Baker, R. T., and Smith, H. G. (1920): A Research on the Eucalypts and their Essential Oils. Rev. ed., p. 323.
Penfold, A. R., and Morrison, F. R. (1927): *J. Roy. Soc. N.S.W.*, *61*, 54.

Zinc Mirrors

In the course of a series of experiments on gas phase kinetics it was found possible to produce zinc mirrors inside quartz tubes, in a way suitable for the detection and estimation of free radicals in gases by the Paneth technique.

The method used was as follows: The transparent quartz vessel was attached to a vacuum system and evacuated to about 0·0001 mm. Zinc diethyl in a reservoir connected through an ordinary stopcock was allowed to volatilize into the quartz vessel, producing a pressure of about 18 mm. The vessel was then irradiated with ultraviolet light from a mercury vapour lamp and the zinc was gradually deposited as a mirror film which was uniform if the light beam was uniform. It was necessary to evacuate the vessel once again before admitting air in order to avoid the deposition of zinc oxide, but, once formed, the film was stable to air.

In experiments where the detection of methyl or ethyl is important, the above method should be easily adaptable and may be a useful variation of Paneth's original procedure, which used a thermal method.

L. E. Lyons.

Department of Chemistry,
University of Sydney,
15 June, 1948.

Views

"Science at the Cross Roads"

In the correspondence arising from Dr. Ilse Rosenthal-Schneider's article on *The Interpretation of Scientific Evidence*[1] she makes the statement[2] that the only version of Hessen's essay on Newton's *Principia*, which is available in Sydney is the Australian reprint.[3] The original English text has, however, been in

[1] This Journal, *9*, 161-166.
[2] Ibid., *10*, 54.
[3] B. Hessen: The Social and Economic Roots of Newton's Principia. 1946. Current Book Distributors, Sydney.

the Sydney Public Library for years. The essay was one of a number of papers delivered at the International Congress on the History of Science and Technology in London in 1931, later published under the title *Science at the Cross Roads*[4] and now out of print. Dr. Rosenthal-Schneider based one of her criticisms of Hessen's essay on a heading, *Science Blamed for the Evils of Capitalism*, which was not used by Hessen and is in fact one of several interpolated by the editors of the current Australian reprint.

Dr. Rosenthal-Schneider criticizes my views on two *Nature* editorials published in 1930 and referred to by Hessen: she endeavours to show that the author of the first of these *Unemployment and Hope*, does not propose the abolition of mass production. No one could say, however, that the wording indicates that the author is very keen on including "large factories". It is not only that the wording suggests the omission of mass production: some, of whom Professor Hessen is one, would doubt the practicability of setting up a stable economic organization in which mass production stands cheek by jowl with cottage industry. It is clear that there are here no legitimate grounds for accusing Professor Hessen of misinterpretation.

In regard to the second article, on *Science and Society*, the writer, although commending the application of science to affairs of State, claimed also that "the elaboration of scientific methods of production is increasing the volume of unemployment". This statement is contrary to Hessen's view that social organization is primarily responsible for unemployment. It seems clear that Dr. Rosenthal-Schneider is not justified in stating that "throughout the whole of the article the use of science for society is most strongly advocated". Hessen's criticism of the article is based on logical grounds. She is herself guilty of misinterpretation when she accuses Hessen of misinterpretation in respect of either of the articles.

The author of *Science and Society* suggests that it is to "creative science" that we must look for a solution of the unemployment problem. He distinguishes between "creative science" and "mechanical invention" . It is not possible to make a clear-cut distinction between these two categories of scientific activity. It is true that "creative science" usually refers to discoveries of principles of more or less far-reaching importance and that the term "mechanical invention" is reserved for practical discoveries generally more limited in their application. The author claims that the discoveries of "creative science" have a beneficial social effect (for example, they create new industries), but he implies that "mechanical invention" often leads to unemployment.

Would that matters were so simple! Mechanical invention is a most important aid to the scientific research worker and is often the vehicle by which his discoveries are carried into effect. It is quite impossible to forecast the effects of a new scientific principle. Maybe it will afford employment in new industries, but that is only one side of the sociological picture. The new industries may employ fewer people than the industries they replace, or an increase in productive capacity may lead to overproduction. It would be impossible to determine the stage at which to stop the application of the discoveries of "creative science" to prevent their contamination by "mechanical invention" and the alleged adverse sociological effects. Even if the views expressed were correct, their practical application would be an impossible task.

R. B. Withers.
Council for Scientific and Industrial Research,
Homebush, N.S.W.,
24 March, 1948.

[4] Kniga, London. 1931.

Alternative Names for Trichosurus vulpecula

In a recent communication to this Journal, *Experimental Transmission of Tuberculosis to Trichosurus vulpecula*,[1] the Editor altered the term possum as used by the authors to opossum. Which of these two terms is correct?

In 1698, the English anatomist Edward Tyson,[2] in his paper *Carigueya, seu Marsupiale Americanum, or The Anatomy of an Opossum*, gave the world the first anatomical description of a marsupial which he had obtained from Virginia. Already Tyson had difficulties with the nomenclature of his marsupial and he mentions at least a dozen alternative names in use in his day. He states, however: "In Virginia and generally by the English 'tis called opossum as by Ralph Hanar and others. Joh. de Latt and Captain John Smith write it opassum. Mr. Ray calls it the possum, as do also our common seamen."

In 1770 Captain James Cook at Cooktown observed animals which reminded him of the opossum as described by Tyson and others. In his Journal, however, Cook referred to them as possums. This historical evidence should suffice to prove that the word possum is not a modern Americanism as generally alleged, but was apparently used in scientific literature for the first time in *Synopsis Animalium*"[3] by John Ray (1627–1705), an English scientist of repute who had never set foot in the New World. In the eighteenth and nineteenth centuries the term opossum became the generally accepted name for the only marsupial occurring in numbers in Northern America, *Didelphys virginiana* Kerr, and today is used as an alternative to the zoological designation. In scientific literature the term possum is never used when referring to *Didelphys virginiana*.

In the middle of the nineteenth century it became accepted that *Didelphys virginiana* belongs to the suborder of polyprotodont and *Trichosurus vulpecula* and other phalangeridae to the suborder of diprotodont marsupials. In

spite of this distant relationship, Australian scientists have insisted on calling *Trichosurus vulpecula* an opossum, a name already given more than two hundred and fifty years ago to a basically different animal.[4] To avoid this somewhat humiliating situation, E. Troughton[5] and others have used the term possum for phalangers, as had already been done by Captain Cook.

In view of these facts, the writer is of the opinion that, in scientific communications, the term opossum should never be used as a name for *Trichosurus vulpecula*. Possible alternatives are "phalanger" or "marsupial foxlet". "Possum", in spite of its derivation, could be tolerated as an old-established convenient term which successfully distinguishes between the American and the Australian species.

A. BOLLIGER.

Gordon Craig Research Laboratory,
Department of Surgery,
University of Sydney,
29 July, 1948.

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(1) BOLLIGER, A., and BOLLIGER, W. (1948): This JOURNAL, *10*, 182.
(2) TYSON, E. (1698): *Philosophical Transactions*, page 105.
(3) RAY, JOHN: As quoted by Tyson, *loc. cit.*
(4) ABBIE, A. A. (1941): This JOURNAL, *4*, 77.
(5) TROUGHTON, E. (1941): Furred Animals of Australia. Angus and Robertson Ltd., Sydney.

Reviews

Authority and Liberty

THE AMERICAN SYSTEM OF FEDERAL GOVERNMENT. By J. H. Ferguson and D. H. McHenry. (McGraw-Hill Book Co., Inc., New York and London, 1947. viii + 972 pp.) Price: $4.50.

The Australian reader of a book like this immediately has two reactions. He envies the multiplicity of American texts which provide a ready reference to the whole structure and organization of government, for there is not a single book of such character describing the Australian political scene. Secondly, he takes comfort from the fact that the federal system of government, which sometimes creaks so ominously in Australia, is working satisfactorily on a much larger and more complicated scale in the United States of America.

The latter point provides the opening theme for the authors of this book. They say that "the American system of government is now, more than ever, the subject of world-wide interest. It has stood the test of good times and bad." Furthermore, "to a world ravished by war, ruthless treatment of minorities, pestilence, hunger and disillusionment, the institutions of . . . the United States are certain to be the objects of envy and emulation by less fortunate peoples", for they have proved capable of maintaining that "delicate balance between authority and liberty".

To this reviewer those last six words are all important. If we believe that both authority and liberty are prerequisites in a system of popular government we must see to it that the structure of government and its administration will promote those objectives. There is little doubt that the natural trend towards centralization presents a constant challenge to the maintenance of such prerequisites, for the natural trend is reinforced by a current desire to concentrate power at the centre, on the ground that the problems of government are of such urgency as to demand immediate action if they are to be resolved. It is persistently alleged that prompt action is impossible to attain if governments have to spend time in consulting each other; that delays and differences are the natural concomitant of a federal system. Someone remarked that the mind of man delights in inventing excuses to justify the things to which his prejudices incline him. Modern jargon speaks of "rationalization", and this term adequately describes the attitudes of those who emphasize the idea of authority, for they resent limitations which consultation and compromise demand.

Men who believe in the imperative need to preserve individual liberty are determined to repel any move that is calculated to leave those in authority with unrestricted power. The ordinary working of parliamentary government, as we in the British Commonwealth understand it, leaves the party in power with the opportunity to do anything it wishes, provided it has the numbers. There would seem to be no effective means of checking arbitrary power in a unitary system if the party in office is willing ruthlessly to disregard parliamentary conventions. On the other hand, a federal system automatically sets limits to the power that can be exercised by any government in the Federation. Each can do only what the constitution allows, and this ensures in a significant degree the realization of the original objective of the American colonists that they should be subject to a government of laws and not of men. In other words, a federal system elevates the principle of liberty while making possible that delicate balance between authority and liberty. It is probable in this age of totalitarianism or at least of authoritarianism that no other form of government can be relied upon to protect the individual against administrative officiousness and political extremism.

The book which has prompted these comments is replete with illustrations of the regard for the rights of the individual. Take the cases cited on pages 163 ff., dealing with the conditions of naturalization, a most touchy subject in these days of harbouring displaced persons. Had not the courts stepped in to restrain the actions of officials, the individuals would have been without redress. In a unitary system the final word would be with the minister, himself the reflection of party political ideas. In a

federal system the minister is as much subject to the law as is the individual affected.

Australians have long become accustomed to recognizing that the High Court is an integral part of the federal system and occupies a strategic position as guardian of the constitution. In America the doctrine of the separation of powers between the legislature, the executive and the judiciary is more clearly written into the constitution and is therefore more strictly applied than in Australia. It is fair to say that the American Courts always leaned to an interpretation of the constitution similar, in the main, to that followed in Australia until the famous Engineers' case. That is to say that when a legislative or an administrative act might be construed as impairing the working of the federal system, the courts in America consistently rejected it. This attitude is usually known as the *doctrine of implied prohibitions*, i.e., the legislature or the administration were prohibited from doing anything which would be contrary to the spirit of federalism.

Nevertheless it is clear to the most casual reader of the book that the balance of power in government in America is surely shifting to the Federal authorities. The war merely accelerated that shift. One only has to scan the headings of the chapters in the section dealing with "Federal Administrative Organization and Functions"—regulation of public utilities, federal enterprises, labour, welfare and social insurance, public works and housing, agriculture, and conservation of natural resources—to recognize that the authorities at Washington are more and more expanding into fields that were hitherto monopolized by the States. In many cases the Federal Government ensures that the States follow its policy by attaching to State grants a condition that the grants are subject to satisfying the requirements imposed by Washington. In others the Federal authorities have undertaken matters that were neglected by the States. Some see in all these developments a steady lessening of the significance and prestige of the States. The key to the problem is finance. The Americans have not even contemplated such a measure as our uniform taxation legislation, which leaves the States entirely at the mercy of the Commonwealth. Nevertheless the resources of the States are relatively much slenderer than are those of the Federal Government, and have to be supplemented by Federal aid.

For the general reader the first section of the book is probably the most interesting. Amongst the topics treated are constitutional principles and problems of change, individual rights, the federal system, interstate relations and centralization, immigration and citizenship, public opinion and pressure groups, political parties, nominations and elections. The text is profusely illustrated by diagrams, charts and graphs. The pictorial representation of the "protections of and dangers to civil liberties" on pages 80 and 96 represent advance made in the use of visual aids.

One last comment. It is probably a characteristic of most reviewers to adopt the role of Oliver Twist. If this one asks for more it is because he has found American local government not merely fascinating but the one part of American administration which is in the tradition of Thomas Jefferson. Just as we suggested that the maintenance of a federal system was an almost automatic restraint upon tendencies to authoritarianism, so we believe that unless a country possesses a virile system of local government, citizen interest in the higher levels will wither, or at least be supplanted by selfish pressure groups. American local government, with perhaps the exception of that of the counties, evokes the enthusiasm of the people in most of the States, and we feel that space rather than substance inclined the authors to skim very slightly over the subject matter of that aspect of government. Or was the space given another indication of their conviction that the balance of power is shifting to Washington? It is a pity that students should get this impression from reading such an excellent text.

It is good that the authors have retained the appendices printed in the original edition. The Declaration of Independence, the United States Constitution, and the Charter of the United Nations, three of the appendices, are documents to which almost every reader needs refer to at one time or another. Usually printed in pamphlet form, they tend to be exasperatingly elusive.

F. A. BLAND.

A Dynamic Text-book

DYNAMIC PHYSICS. By Bower and Robertson. (New York: Rand McNally and Co. Our copy, Angus and Robertson, Sydney. 854 pp., 398 text figs. and photos., 6″ × 8¾″.) Price: 21s. (Austr.).

Any teacher of elementary physics with a guinea to spare for a new text-book would find that guinea well spent on Bower and Robinson's *Dynamic Physics*, with its 854 pages and its 398 figures and photographs. It is, as the name itself rather suggests, an American book; and it exemplifies very well much that is admirable and much that, as some of us would contend, is deplorable in present-day American high school science texts.

A teacher would enjoy, as did the reviewer, the magnificent photographs with which the book abounds, and at the same time would find some challenging entertainment in attempting to puzzle out just what in physics is illustrated by some of these same magnificent photographs. He would marvel at the quality of production in what is, by present standards, a moderately priced book. He would be eager to see whether the authors make good the claim stated in their preface, that their

methods of presentation "make the contents interesting, meaningful and purposeful to the learner". He must approve of their thoroughness and courage in including a glossary—a glossary which, as they themselves say, "is distinctive because (1) the list of technical terms is comprehensive . . .; (2) the definitions are simple . . .; (3) no undefined terms are included in the definitions".

One may be surprised at that third claim, with its apparent admission of circularity in the definitions, and one could indeed, if his interests so inclined, derive some innocent and profitable amusement in unearthing the many circularities in these glossary definitions. A teacher of physics would probably be distressed by much looseness, superficiality and downright error in the body of the text; yet perhaps in the end he would conclude that the book, despite its faults, is at least a text that school pupils would gladly read.

Up-to-the-minute automobiles and streamlined locomotives career through chapter after chapter (or "area", as the modern terminology goes); the latest aircraft flash through page after page. No modern youth, it could be contended, can fail to be interested in a physics that takes its stand upon automobiles, streamlined trains and the newest aircraft. That, surely is the way to teach real science! Maybe it is—but the reviewer at least remains unconvinced and would like the reader to look seriously at the fundamental questions of teaching which can be raised here.

There was a time, of course, when school physics was no more than an attenuated and truncated version of university physics. The main emphasis was placed on the systematic expositions of fundamentals as a basis for later more advanced work. The presentation was essentially mathematical and deductive: pupils were occupied with little more than routine tricks with formulae. They manipulated symbols, but did no thinking; substituted in formulae, but made no discoveries. Sometimes they might undertake the formal verification of a law, but never its critical consideration. The everyday applications of physics were considered not as being important in their own right, but only (if they were considered at all) incidentally and just as illustrations of fundamental laws. These applications, of course, were carefully handpicked, because they commonly and rather distressingly refused to be adequately described by the formalized categories of school physics.

One absurdity of such a presentation of physics was that most pupils did *not* in fact go on to take up advanced work in the subject. They spent their time at school preparing for something that did not happen; they were denied the opportunity of preparing for things that certainly did happen. They became, many of them, skilled at solving problems in geometrical optics, but remained, most of them, quite uninformed about sensible home lighting. Ohm's law they thrashed out thoroughly; radio was left to the hobbyists. Thus at length the demand grew for a school physics which would be a part of preparation for living (as the slogan went) and not just preparation for more physics.

More important still was the recognition that the watered-down university physics doled out to school students was a mockery of all that is meant by science as an *outlook*. Physics was authoritative and dogmatic, and left no room for wonder. It was abstract and artificial, and left no room for significant observation. It was formal and systematized, and left no room for constructive thinking. It was hopelessly dull, and left no room for enjoyment. And so the demand grew for a school physics that would be enlivened by the true spirit of science; for investigations in which pupils would delight to take part; for problems that would challenge them to careful observation and thoughtful analysis; for methods of presentation that would encourage them to be critical.

The book under review claims to meet these two demands: it claims to present a physics which is at once a preparation for coping with what the authors call "the present mechanized environment", and to be a stimulus to *critical* thinking "as a basis for intelligent action in a democracy". As to the former of these two claims there could be some debate: the point could be made that the catch-cry about coping with the present mechanized environment just has not any meaning. One can cope in a variety of ways with environments, mechanized and other, and can cope quite satisfyingly with them without any knowledge of physics. The second claim, that the book is a stimulus to critical thinking, must be entirely disallowed.

The fact is that for the old dogmatism and verbalism about *laws and formulae* these authors substitute a new dogmatism and verbalism about *gadgets*. Despite what they pretend, most pupils do not have any *significant* experience of gyro-compasses, airfoils, radiosondes, diesel engines, carburettors, fluid drives, air-fuel meters and the many other ingenious devices which are featured here. There just cannot be any critical or speculative or even observational approach by pupils to their long list of such topics. For instance, in Area 3 of Unit 12 the authors pose the question: "How are radio waves changed to spoken words?" A block diagram of a superheterodyne receiver is given and the authors go on to say:

> "The voice-modulated radio-frequency waves are interrupted by the antenna and amplified by the radio-frequency amplifier. They are then passed on to a mixer tube. In this tube they are superimposed upon ether waves of different frequency, originating in a local oscillator-tube circuit. A beat frequency is produced in this mixer tube just as beats are produced in the ear when two sound waves of nearly the same frequency are mixed. The ear hears both the sound waves and the

beat note. Both the radio-frequency oscillation and the beat frequency are passed to the intermediate-frequency amplifier. But the frequency amplifier [*sic*] is tuned to receive the beat, or intermediate frequency, and consequently accepts only one. In many receivers the intermediate frequency is 485 kilocycles."

This sort of exposition, whatever it might be called, is certainly not scientific physics at any level. It illustrates very well the improper substitution of *metaphor* for meaningful description, and it brings elementary physics no closer to real meaning than do the most artificial problems on the combined capacities of condensers joined in series. It could stimulate critical thinking only in the mind of someone who already knew the facts and was horrified at this mangling of them.

Again, after a brief introductory paragraph on centre of gravity, in which the main assertion is that "in general, the lower the center of gravity in an object, the more stable is the object", the text plunges straight into a discussion of "The Stability of an Airplane". There are some impressive diagrams and a picture (supplied by United Air Lines) which ought to help boost air travel; but the main findings here are:

> "The center of gravity, as in any other object, is the point where the mass of the airplane centers with reference to its weight. Also, since the three axes intersect one another at this point, it is the center of all the forces acting upon the airplane. The location of this center is exceedingly important, for the weight of the airplane must help to counteract the forces acting along the various axes. Thus designers in planning the parts of an airplane work hard to obtain a suitable center of gravity for the parts as a whole, and pilots watch to see that passengers and cargo disturb the center of gravity as little as possible."

Words, words, words! Here is physics reduced to the level of advertising patter!

Almost any page will provide similar illustrations of the hollowness of such sham physics. Here is a final quotation, following the heading "The Magnetic Compass":

> "Shortly after the ancients discovered the lodestone and learned how to make artificial magnets, they began to use magnetized bars for determining directions. Near the end of the thirteenth century, about two hundred years before Columbus discovered America, the device known as the compass came into use. This device exerted a great influence upon the world because up to that time sailors had no accurate means of telling directions once they lost sight of land. With the aid of the compass, however, they began to travel farther from shore and finally made many notable discoveries, including the discovery of the continent on which we live."

We who take our science seriously might begin to think, after such a paragraph, that the book is a hoax perpetrated by the versatile authors of *1066 and All That*, now branching out into physics, if we were not forthwith plunged into the inevitable aeronautical illustration with a discussion of magnetic compasses used in aircraft, chiefly memorable for an accompanying photograph of an impressive instrument panel—supplied once more by United Air Lines. This same section includes the following stimulus to critical thinking:

> "The compass of an airplane is exceedingly sensitive and hence is affected by the near-by metal parts of the airplane and other distorting factors caused by the electric current."

This, be it noted, is near the beginning of the first discussion of magnets. Presumably, if a sufficiently critical boy were to ask, "To what in particular are compasses sensitive?", the answer would be, "To nearby metals". (Metals, evidently, are to be counted among the "distorting factors caused by the electric current.")

There is no need to multiply examples of the superficiality, inaccuracy and careless writing which mar every chapter of the book. It has its merits, but they are on the surface; its weaknesses are fundamental.

J. B. THORNTON.

Agriculture

A CATALOGUE OF INSECTICIDES AND FUNGICIDES. Vol. I, Chemical Insecticides. Compiled by Donald E. H. Frear. (Waltham, Mass., U.S.A. The Chronica Botanica Co.; Melbourne, N. H. Seward, Pty., Ltd. 203 pp., 8″ × 10½″.) Price: \$6.50.

Until a few years ago the farmer was dependent on a few relatively simple chemicals to aid him in his contests against pests and diseases which attacked the plants he sought to cultivate. He employed compounds of arsenic and fluorine to kill biting and chewing insects, and sulphur and plant extracts such as nicotine, rotenone and pyrethrum to deal with aphids, bugs and other sucking insects. He used petroleum and other oils to smother scale insects. For the control of fungous diseases he favoured compounds of copper, zinc and mercury.

These materials were not always highly efficient; some proved toxic to the plants they were aimed at protecting and others involved a public health risk from poisonous residues on food crops. The discovery of certain synthetic organic chemicals, such as the organic thiocyanates and chloronil, with promising insecticidal and fungicidal properties, focused attention on "organics", and interest was intensified when D.D.T. developed its fine record in World War II. Restrictions on supplies of copper and zinc during the war also encouraged the search for substitute

organics. As a result many thousands of compounds have been screened in the search for useful insecticidal and fungicidal properties, and the literature to be covered by the research worker in this field is now not only voluminous but is widely scattered. Professor Frear's catalogue has been prepared to assist the newcomer to this field and to serve as a reference aid to those working in it.

The catalogue was prepared as part of a project of the Pennsylvania State College (where Professor Frear holds the Chair of Agricultural and Biological Chemistry) aimed at developing new insecticides and fungicides. As a background for future work it became necessary to collect and correlate all pertinent facts, and the catalogue covers briefly the results of the biological testing of approximately 10,000 materials, with references to the original work.

One of the chief difficulties encountered by the author was the problem of how to classify the numerous diverse chemical compounds. He decided that any simple system, such as an alphabetical arrangement, did not take into consideration the chemical relationships involved, and he devised an entirely new system of classification. The system evolved consists of assigning to each chemical compound a "code number". This is made up of the numbers assigned to each constituent group present in the compound according to a pre-arranged code list which is provided. In use, the constituent groups in each compound to be coded are assigned numbers beginning with the one bearing the lowest number and followed by other constituent groups in numerical order. The length of the code number for any given compound will depend upon the variety of constituent groups present in that particular compound. Reference to the code list shows that organic groups are selected first and inorganic last, this constituting the first subdivision. Compounds containing both organic and inorganic groups are then accommodated with numbers from both these large divisions. The compounds listed in the catalogue are arranged in order of their code numbers. This results in placing together all compounds with code numbers beginning with the same constituent groups. In locating a given compound in the catalogue it is suggested by the author that the easiest way is to code the compound required and then look under the code number in the catalogue. For example, if it is desired to find acetic acid, it is coded as 541-1011 and this code number is located in its proper numerical sequence. For the convenience of readers who prefer to locate compounds by name, a complete alphabetical index of all compounds is given at the end of Volume II.

Professor Frear and his collaborators are to be congratulated on the acomplishment of the huge task of assembling and arranging in logical chemical sequence relevant data on the toxicity of many thousands of chemical compounds, with appropriate literature references, but the reviewer wonders if the whole plan is not marred by the inclusion in the catalogue of the somewhat intricate coding system of approach to its contents. Judgment on this must be deferred until Volume II comes forward when it can be determined how usable the catalogue is with the aid of the alphabetical index to compounds provided only in that volume.

The Chronica Botanica Company is again to be commended for its excellent handling of the publication, for the clear type chosen, the non-glossy paper, which allows hours of stu... in artificial light, and for the styling of the vignettes.

C. J. MAGEE.

Biochemistry

NATURE OF LIFE: A STUDY ON MUSCLE. By A. Szent Györgyi. (Academic Press, New York. 90 pp., 17 plates, numerous text-figures.)

This small volume comprises a series of lectures delivered by Professor Szent-Györgyi at the University of Birmingham and the Massachusetts Institute of Technology during 1947. He has, as he states in the foreword, attempted to present a brief summary of the war-time work of his laboratory in Hungary, previously published in detail in "Chemistry of Muscular Contraction".*

The first chapter discusses muscle histology as revealed by the electron microscope, then proceeds to an account of colloid properties relevant to the structure of muscle. It is emphasized that the finest contractile filaments are uniformly doubly refractive, and that the periodic double refractivity of striated muscle depends not on the contractile elements, but on the interfilamentary substance. Just as fibrous colloids under mechanical stress may assume periodic double refractivity, so in muscle this appearance is the result of and not the cause of contraction; this explains why smooth muscle, which works slowly and against little resistance, is free from striation.

The next two chapters deal with the constituents of the contractile filaments, actin and myosin, and their conjugated form, actomyosin, which corresponds to the "myosin" of previous writers. This apparent confusion in terms Professor Szent-Györgyi neatly avoids by saying that it is not the nomenclature that is bewildering, but the facts. Myosin is an intricately organized protein containing, firstly, attached enzyme-like "protins" responsible for dephosphorylation and de-amination of adenosine triphosphate and diphosphate and also concerned in contraction; secondly, adsorbed adenosine triphosphate (A.T.P.) radicals, these being supposed to have a nuclear function, except that the larger nucleic acid radical is

* Reviewed in this JOURNAL, *10*, 116.

replaced by the smaller A.T.P., thus streamlining, as it were, for rapidity of contraction. Actin, the other constituent, exists in either the G (globular) or F (polymerized fibrous colloidal) forms, the reversible change being the basis of the contraction cycle.

The conjugate acto-myosin, unlike either of its constituents, is contractile, even *in vitro*, this being dependent on the complex interrelationships of the concentrations of A.T.P. and calcium, potassium and magnesium ions. Acto-myosin fibres *in vitro* are indistinguishable from the contractile filaments of muscle when viewed with the electron microscope, but show certain differences in their behaviour with the substances mentioned above.

Consideration is next given to energy exchanges, and it is shown that "relaxation" is the process requiring energy, just as a rubber band needs energy for stretching, but liberates mechanical energy on contracting. Finally, some physiological aspects are discussed, namely, the physico-chemical nature of the resting state (actually an unsolved problem), excitation, heat rigor, and *rigor mortis*.

This book should provide stimulating reading for those interested in physical chemistry, biochemistry and physiology. It is within the scope of senior science students.

N. J. Rothfield.

Chemistry

Solid Luminescent Materials, Preparation and Characteristics of. Edited by Gorton R. Fonda and Frederick Seitz. Symposium held at Cornell University, October, 1946. (Published under the auspices of The National Research Council by John Wiley and Sons, New York; Chapman and Hall, London, 1948. 459 pp, numerous text-figures, 9″ × 5½″.) Price $5.00.

Not many years ago luminescent solids or phosphors were regarded as scientific curiosities, but in the last fifteen years they have become materials of widespread use and importance, particularly as a result of war-time developments. The first suggestion that phosphors had any commercial value brought with it a flood of patents claiming both new phosphors and new methods of producing well-known phosphors. Even now far too much effort is directed into wholly empirical channels on preparative methods and new materials, and insufficient into the fundamental issues of luminescence. Fortunately the proceedings of a symposium on the subject, reported in the book under review, indicate a healthy interest in the fundamentals and a recognition of the part which a study of this phenomenon can play in providing a better understanding of the solid state.

With one exception, contributors to the symposium were drawn from organizations within the United States. They include many active and well-known workers in the field. The papers are presented in groups under several general headings, relevant comments on the papers being included in appropriate places.

The first group of papers, introduced by F. Seitz, deals with general characteristics and preparative methods and serves to illustrate difficulties in the production of materials whose luminescence depends on the presence of one part of an activating impurity in 10^4 to 10^6 parts of base material. The term "luminescence pure" has been coined by Leverenz to represent the standard of purity necessary in this work. A greater appreciation of the significance of parts per million of impurities and of slight physical disturbances to the crystal structure is leading to a resolution of many of the differences of experimental fact and opinion which have existed in this subject. Subsequent papers deal with recent advances in theory and experiment, particularly in relation to the storage of energy in electron trapping levels. An account of the work initiated by J. T. Randall at Birmingham is given by Garlick and the basic principles governing the action of infra-red storage phosphors are outlined by Urbach.

Some of the papers in the next group contain accounts of a great deal of empirical work on sulphide and selenide systems; these do not appear to have any fundamental value at present. Several important papers on the storage of luminescence follow; of particular interest is an account of the application of the theory of rate processes to the interpretation of the luminescence mechanism by Eyring and F. E. Williams. Miscellaneous aspects of the subject are treated in the final group, including photochemical effects accompanying luminescence, reactivation of phosphors and the print-out effect in silver halides. The concluding discussion of the symposium gives the reader many useful indications of the trends in research and thought on this fascinating subject and is well worth study.

The book lacks the continuity of a monograph, of which there are none of any distinction on the subject. There are a few minor errors, especially in the mathematical expressions, but this is a state of affairs, which, regrettably, one has come to associate with first editions. It is, however, by far the most instructive volume on the luminescence of solids to date and should be read by all who have any interest in the physics and chemistry of the solid state. In an otherwise admirably produced book it is a pity that the few half-tone reproductions are so poor.

A. L. G. Rees.

Organic Syntheses. Vol. 27. (New York: John Wiley and Sons, Inc. London: Chapman and Hall. 121 pp, 9″ × 6″.)

This is the twenty-seventh volume in the series of recommended methods for the preparation of selected organic compounds which had its origin almost thirty years ago

in some University of Illinois bulletins. The present volume is of the same high standard as the previous volumes in the series and will prove just as useful. In it methods of preparation of 39 different substances are described by 52 different collaborators in addition to members of the editorial board, the range of reactions involved and chemical types prepared being quite wide. The table of contents lists the preparations of β-alanine, β-aminopropionitrile and *bis*-(β-cyanoethyl)-amine, benzalacetone dibromide, biallyl, α-bromobenzalacetone, *tert.*-butylamine, carbomethoxylamine hemihydrochloride, decamethylene diamine, diethylaminoaceto-nitrile, dihydroresorcinol, 3,5-dimethyl-4-carbethoxy-2-cyclohexen-1-one and 3,5-dimethyl-2-cyclohexen-1-one, 1,5-dimethyl-2-pyrrolidone, 2,3-diphenylindone (2,3-diphenyl-1-indenone), 2,4-diphenylpyrrole, ethyl α-isopropylaceto-acetate, 4-ethylpyridine, glycolonitrile, 5-hydroxypentanal, isatoic anhydride, 6-methoxy-8-nitroquinoline, 1-methyl-2-imino-β-naphthothiazoline, N-methyl-1-naphthylcyanamide, 1-methyl-1-(1-naphthyl)-2-thiourea, mucobromic acid, *m*-nitrodimethylaniline, 3-penten-2-ol, γ-*n*-propylbutyro-lactone and β-(tetrahydrofuryl)-propionic acid, pseudothiohydantoin, rhodanine, stearolic acid, tetraiodophthalic anhydride, *m*-thiocresol, *o*-toluic acid, *p*-toluic acid, *o*-toluidinesulphonic acid, and 1,3,5-triacetylbenzene.

Many of these substances are particularly important laboratory intermediates — e.g., β-alanine, mucobromic acid and rhodanine. It is also worthy of comment, too, that many of the starting materials used in this batch of preparations are chemicals once considered rare but now readily available commercially—at least in America!

F. LIONS.

Engineering

VACUUM-TUBE CIRCUITS. By Lawrence B. Arguimbau. (New York: John Wiley and Sons; London: Chapman and Hall. 668 pp., numerous text-figs, 5½" × 8½".) Price: $6.00.

As the author states in his preface, his objective in this book is to discuss general methods by which engineering problems relating to vacuum-tubes can be solved. Specific circuits and techniques of current interest are subordinated to more general methods of attack and underlying physical principles. This objective has been attained, the result being a very useful text-book for students and reference book for radio engineers who need to revise one phase or another of the general principles of vacuum-tube techniques.

Before tackling this text a student should have a knowledge of alternating current circuits, calculus and Fourier series. A prior knowledge of the physics of vacuum-tubes is desirable but not necessary, as enough of this material has been condensed in the early chapters. The book is sufficiently comprehensive to permit the acquisition of a thorough general working knowledge of vacuum-tube circuits and techniques.

The text is profusely illustrated, there being fifty or more diagrams in some of the twelve chapters. Also of value to the student are numerous examples, some of them worked out to illustrate methods. References to the original text on many of the subjects dealt with and to sources of further detailed information are supplied throughout.

Of the twelve chapters, the first constitutes an introduction, discussing the elementary principles of radio communications, sound broadcasting, television, modulation both amplitude and frequency, and amplification. The remaining chapters may be divided into three groups, the first dealing with the more general properties of vacuum-tubes and their associated circuits. In these three chapters are discussed diodes and rectifiers, triodes and pentodes, and the properties of linear amplifiers; a discussion of thermal agitation noise, vacuum-tube noise and other sources of noise is included. One chapter is devoted to a very satisfactory discussion of inverse feedback, including a full treatment of the widely used cathode follower.

In the second group, of five chapters, I include those dealing with non-linear amplifiers and oscillators. These include treatments of amplitude modulation and tuned amplifiers, tuned coupled circuits and sidebands. Power amplifiers are dealt with in one chapter including treatments of class B audio amplifiers and class C radio-frequency amplifiers and frequency multipliers; some types of oscillators are treated in another chapter. The remainder of this group consists of chapters providing more detailed discussion of amplitude and frequency modulation, including frequency converters, detectors, limiters, discriminators and frequency modulation spectrum.

The remainder of the book is devoted to techniques relevant to television (and, of course, radar). One chapter is devoted to transient response and video amplifiers, and considers square wave response and compensation; another deals with other circuits used in television techniques, such as pulse-forming and sweep circuits, trigger circuits and pulse modulation.

The final chapter deals with microwaves, treating negative grid triode oscillators, positive grid oscillators, magnetrons and klystron amplifiers and oscillators.

J. H. PIDDINGTON.

SOIL MECHANICS IN ENGINEERING PRACTICE. By Karl Terzaghi and Ralph B. Peck. (New York: John Wiley and Sons; London: Chapman and Hall. 566 pp., 218 text-figures, 6" × 9".) Price: $5.5.

As implied by the title, the authors have emphasized the practice of soil mechanics rather than its theoretical development. To

this end the text has been divided into three sections, the first two dealing with the physical properties of soils and with the usual theoretical developments of earth pressures and hydraulics of soil moisture respectively. Together these sections constitute half of the text. The remainder of the book is concerned with soil exploration and the discussion of problems arising in practice. It is in this section that the authors have made a contribution to the literature of soil mechanics.

Usually writers on soil mechanics have dealt with refinements in testing procedures and mathematical developments of theory, which have obscured the intrinsic uncertainty of soil as a material and have given rise to an unjustified belief in the accuracy of forecasts of soil behaviour made on the basis of these treatments. In this text such pitfalls have been avoided. By discussion and analysis of a wide range of failures and successes as given in published literature on the subject, the authors show the limitations and assistance of soil mechanics to the practising engineer. Moreover, wherever possible, explicit direction is given to the designer. Unfortunately, certain fields of application of soil mechanics have been omitted, in particular applications to highway engineering.

In conclusion it may be said that this is a book for practising engineers, for whom the third section should fill a long-felt want, and to whom the first two sections will give a more than adequate insight into the strength theories and physical concepts of soil masses as generally accepted at present.

C. A. M. GRAY.

PRINCIPLES OF JET PROPULSION AND GAS TURBINES. By M. J. Zucrow. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall Ltd. 563 pp., numerous text-figs., 6″ × 9½″.) Price: $6.50.

Jet propulsion, in the wider sense of the term, is by no means new. It follows from momentum considerations that an aircraft can be propelled forward against a resistance only by the rearward ejection of a jet of some sort. But the term is commonly given a more restricted meaning to include only those systems in which the propulsive jet is identical with the air stream which takes part in the thermodynamic cycle in the driving engine. It is these comparatively new systems of aircraft propulsion with which Professor Zucrow's timely book is concerned, although, surprisingly, he includes a chapter on the propeller.

The gas turbine is an essential component of all practical jet propulsion systems and the greater part of the book is devoted to this prime mover. There has been, as far the writer knows, no authoritative work on the gas turbine since Stodola's classic "Steam and Gas Turbines" was revised in 1927. Zucrow covers a much narrower field than Stodola, but he presents his information in such a way that it will be more readily assimilated by the student.

It is unfortunate that Zucrow has not drawn on the vast amount of information on recent developments which was "classified" during the war but has now been published, especially since a great deal of it deals with principles as distinct from practice. An example is Howell's work on the design of axial compressor blading (Aeronautical Research Council, R. & M. 2095), inclusion of data from which would have improved the very brief section on axial compresors. It is surprising to find that there is no treatment of the radial variation of the flow parameters. While this variation complicates the theory, it is essential that it be considered in any turbine design; if it is neglected such quantities as degree of reaction become meaningless.

The book concludes with chapters on the rocket motor and high temperature metallurgy. One feels that the author has attempted to cover too wide a field, with the result that the treatment of some topics is rather superficial. It is doubtful whether, in a book intended primarily for students, it is necessary to include a long preliminary discussion, occupying almost half the book, of such topics as dimensional analysis, elementary fluid mechanics, the thermodynamics of gas flow and even airplane performance calculations. The student might be expected to have other texts to which he would refer for information on these subjects.

M. W. WOODS.

POWER SYSTEM STABILITY. Volume I: Elements of Stability Calculations. By Edward W. Kimbark. (New York: John Wiley and Sons; London: Chapman and Hall. 355 pp., 68 text-figs., 5½″ × 8½″.) Price: $6.00.

Compared with Selden B. Crary's book which was published by the same publisher as Volume II under the same title, Kimbark's book goes into much more detail in the explanation of fundamentals. It can, therefore, be recommended strongly to any reader who has not gone deeply into the questions of power system stability.

In six chapters the stability problem in general, the swing equation, the solution of networks, including the solution by the help of network analysers, the equal-area criterion, the complex of questions connected with the clearing time of faults and faulted three-phase networks are dealt with thoroughly. Four stability studies of actual networks that were made possible by the courtesy of operating and engineering companies, and that extend over nearly 100 pages, conclude the book and appear to be a particularly interesting feature.

L. TASNY.

The Australian Journal of Science

VOL. XI October, 1948 No. 2

No! No! A Thousand Times No!"

PROFESSOR A. A. ABBIE.*

VIEWS on the probable future of human evolution are necessarily based upon what happened in man's past. That should provide some pointers to what the trend may be. The trend is implied in the title of this paper, which contains the time-honoured protest of the Victorian heroine—a protest that has now fallen into such disuse that it may safely be employed as a text for the present discussion. The thesis is that man's present position depends mainly upon the refusal of his ancestors to entertain sundry attractive evolutionary propositions offered to them in the past. This paper deals only with some of the most decisive refusals and is restricted almost entirely to the vertebrates.

A major event was the emergence of the back-boned animals from some invertebrate group. After much controversy over which group was concerned, and the mechanism involved, it now seems that the group belonged to the Echinodermata—represented today by such unlikely-looking candidates as the sea urchin and starfish. Of greater interest is the mechanism which represents one of the most important "noes" in evolutionary history. The putative ancestor refused to grow up like its relatives and retained the larval form throughout life. In that condition it was able to effect subtle structural modifications which laid the foundations for all future vertebrate organization.

All the major vertebrate groups betray one important feature in common. The major factor in the success of each was adaptational perfection to some environmental niche. Specialization is the secret of success: the earlier specialization is adopted, and the more perfect it becomes the sooner and the more completely is success attained. Specialization spells security; security ensures survival and success; success leads to greater size and further security and, so, to dominance in the group. Thus it continues—provided that the conditions that bred the initial specialization persist.

But what if the environment changes? It is an important and widely valid generalization that evolution is irreversible: thus, the more perfect the specialization the more remote is the prospect of modification to new conditions. The specialized successes are at a disadvantage while the "marginal groups"—the unspecialized poor relations—are offered a virtually new world to conquer. Evolutionary history records numerous examples of the extinction of dominant giants, leaving the line to be continued by smaller and less pretentious representatives. The fate of these giants reveals what handicaps size and specialization impose when the conditions that brought them forth disappear. This is in harmony with the complementary observation that the rise of each new vertebrate group has coincided more or less closely with some major environmental change.

Actually, the advantages gained from living dangerously in non-specialization were greater than at first appears: the unspecialized survivors not only adapted themselves to new conditions—they also became progressively more independent of those conditions. Amphibians are largely independent of water except for breeding; reptiles are independent of water for that also, but they remain at the mercy of the temperature; mammals have become practically independent of temperature as well. Any minor specializations entailed are amply compensated by release from the necessity for grosser specialization. All this does not detract from the basic thesis that new avenues of development were open

* University of Adelaide. An address given to the South Australian Division of the Australian Association of Scientific Workers on 26 May, 1948.

only to those animals that had refused to permit their future to become irrevocably mortgaged to the cause of immediate security.

The first mammals were small mouse-like creatures, represented today by the various groups of shrews found in most parts of the Old World. Like their predecessors, they invaded every economic niche, and in their turn succumbed to the lure of specialization. They became adapted to open country, forest, air, sea and so on; and, again, specialization for security led only into irretrievable bondage to some environmental sanctuary.

All—save one group that took to the trees for a time. That semi-aerial medium enhanced the importance of vision at the expense of smell; the snout became progressively less developed and the eyes looked more and more to the front until binocular vision was achieved. Also, to exploit fully the possibilities of the three-dimensional environment the hindlimbs were modified to take the body's weight, leaving the hands free to grasp branches for support. This led to the upright posture, with free forelimbs capable of grasping things to bring them under the scrutiny of stereoscopic examination. The more precise source of information and the necessity for more exact motor control combined to produce progressive expansion of the brain. Of the attendant structural innovations only that in the hindlimbs involved specialization; reduction of the snout, upon which binocular vision depends, really disclosed a progressively more emphatic refusal to enter upon a path of specialization to the sense of smell; the hands, too, remained primitive and unspecialized.

Some of these animals remained in the trees and became even better adapted, but their hands became more specialized for swinging from branches and little further progress was made towards mastering the upright posture and hand-eye coordination, and cerebral development was checked. The survivors of this group are represented by most of the modern monkeys. Some of the group returned to the ground. If the descent was made too late the arboreal specializations did not allow perfection of the upright posture, etc., and so arose the modern apes. But if the descent was early enough much more was possible. The erect posture was perfected by further modification of the hindlimbs—notably in the development of foot arches and a true heel. To compensate, the hands were capable of almost anything, binocular vision improved and the way was open to enormous cerebral expansion. Progressive enhancement of these characters led to the emergence of man about a million years ago.

This brief survey shows that at every important epoch, no matter how attractive seemed the prospect of some specialization, the proper and ultimately successful answer was nearly always "No!". No extreme adaptation to any particular way of life or any exclusive environmental niche; no settling into a safe, comfortable rut for ever, but always the ability to use somebody else's rut for a while and then move on. And so, collecting nothing superfluous on the way, ultimately to emerge with much of value gained and a large inherent reserve to cope with yet further environmental adventures. The reason for the title should be apparent; and now this principle may be applied more closely to man.

Man has many things in common with his nearest relatives, the monkeys and apes, but it is more instructive to dwell upon the differences. One striking difference appears in the interval between birth and the attainment of maturity. On the criterion of dental development the monkey is mature at about seven years, the chimpanzee at ten years. Modern white man is not mature until about eighteen to twenty years, although the gap between him and the apes can be partly filled by interpolating in order ancient man and some modern native peoples.

Not only does modern white man mature much later than the monkey and ape, in many respects he never matures to nearly the same extent. This is well seen in the skull which at the time of birth is not strikingly dissimilar in all three groups. But in seven and ten years respectively the monkey and chimpanzee have big jaws and eyebrow ridges, the bones are thick and the joints are well on the way to obliteration. Modern man, even after twenty years, still has small jaws and eyebrow ridges, thin bones and un-united joints. Further, while the monkeys and apes have full sets of large teeth in their ample jaws, the human teeth are smaller and the last teeth are becoming entirely suppressed. There are other criteria. The monkey is born with a complete

coat of hair; the ape is born with less and covers over later; man is born with very little and never acquires more than a very restricted amount. Also, monkeys and apes are born with fully pigmented skins; modern coloured peoples are born white but pigment over in a few weeks; modern white man is born white and stays so.

These examples show that despite the fact that human development is becoming more protracted it is becoming less and less complete. There is a progressive tendency to cling longer and longer to the physical standards of the newly-born or even the unborn fœtus. The tendency is called "fœtalization", or, applied to the whole animal kingdom, "neoteny". This refusal to grow up or, rather, to exploit all the specialized extremes of bodily differentiation, must be considered a major example of those biological "Noes!" which have played such an important part in evolution.

The process of fœtalization may be looked upon as something of a race between bodily differentiation and the onset of physical maturity. Maturity implies attainment of a size and differentiation fit for reproduction—the sole reason for the whole business—and its early onset obviously carries many communal advantages. Yet the greatest success has attended the human in whom maturity is deferred the longest. Fœtalization protracts development and is antagonistic to maturation, and it is clear that some of the physical changes described cannot be regarded as obviously advantageous. There must be some merits, however, and these can be appreciated if the process is viewed as a sort of slow-motion film which permits the elaboration of events previously hurried along, and may even reveal some which had been unsuspected. In the present context, fœtalization shifts the developmental emphasis down the scale upon hitherto suppressed characters. Since some of these have been found not to be obviously desirable, so it is necessary to look for others that might be beneficial.

Bodily growth and differentiation are governed by an axial gradient whose maximum intensity is at the head end of the body. As differentiation proceeds the intensity at the head end gradually drops and that at the hind end rises, and if the process lasts long enough the hind end catches up. Monkeys and apes never grow for as long as man and their inferior extremities are relatively stunted in comparison. Man, therefore, ends up with longer lower limbs and generally greater stature. There is no apparent advantage in this; and to seek the advantage it is necessary to turn to the head end of the gradient. Here, if the drop in growth intensity can be deferred for even only a short time the head, and with it the brain, will have a better chance to expand. That is what happens. At birth the human brain is only about one-quarter its adult size, and even after fourteen years—when monkeys and apes are quite mature—it still has some way to go. In the outcome, the smallest adult human brain is twice the size of that of the largest ape. This enormous increase in brain size is the most important gain from fœtalization and extended growth.

Mere size of brain, as such, is not the deciding factor, for the elephant and larger whales have brains that are absolutely larger, although relatively smaller. On the other hand, the little marmoset has a brain absolutely smaller but relatively larger. Also, above a fairly definite minimum, the range of normal variation in human brain size is very wide—the biggest being much more than twice the size of the smallest—and there is no particular correlation with mental attainment. It must suffice here that fœtalization has carried the human brain to such absolutely and relatively adequate dimensions.

What, then, distinguishes the human brain apart from size? The answer seems to lie with the tremendous development of the cerebral hemispheres of the forebrain which have gained most from the increase just noted. In submammalia the hemispheres are very small and the highest seat of control resides below, in the midbrain. Stimulation of the submammalian midbrain either evokes a more or less automatic response, even if dangerous; or there is no response—it is inhibited. The tendency is to either "all" or "nothing". In mammals, control is progressively transferred to the cerebral hemispheres, which show a progressive expansion. As the control shifts the nature of the response changes. It tends to be less and less "all or nothing" and more and more adapted to the exact needs of the moment. There is a gradually widening of the

scope of the response in conformity with variations in the situation and the capacity for variation is greatest in man.

A little consideration will disclose that this ability to vary response really depends upon the capacity to interpose more or less of inhibition at suitable points in the total performance. As cerebral control becomes progressively more complete the interval between "all" or "nothing" gradually becomes filled in by a successively more complete series of combinations of "all" and "nothing" until there is a continuous range of gradations from one to the other. Obviously, an important change here is on the "nothing" side; but this is merely another way of saying "No". If total inhibition is fancifully regarded as a loudly shouted "No!", then the whole interval between "nothing" and "all" ultimately becomes filled with a succession of "Noes" which range from a shout to a whisper before dying away altogether. Here, it is of interest to note that neurologists have recently identified inhibitory areas in the cerebral cortex.

This increased variability of response necessarily accompanies an increasing intellectual awareness of the total situation. Neither is of use without the other and the two together are responsible for the cerebral expansion which reaches its acme in man. The point is, that the growing ability to say "No" with ever more finely shaded emphasis forms an essential part of the development which has determined man's mental and, therefore, complete superiority over all other animals.

That closes the subject of the past and raises the problem of the future. Any forecasts involve speculation upon what might happen if the processes here described continue, and are subject always to correction in the event. Some qualification is necessary. If any major environmental change, such as another ice age, occurs before man is able to cope with it on an adequate scale, it is probable that the evolutionary emphasis will come to favour characters other than those which distinguish modern white man.

There are two separate and antagonistic trends in human evolution: one is prolongation of the growing period towards the maximum differentiation possible, the other is fœtalization which tends to defer differentiation as long as possible. If the future involves only an extension of the growing period it will produce further increase in body size, probably with greater emphasis upon the inferior extremities. There are, however, limits to the extent to which simple increase in bulk can be useful. Beyond the optimum further expansion becomes literally a growing handicap—but there is no guarantee that human growth will cease at the optimum. However, the associated deferment of maturity should produce a corresponding deferment of old age and a progressive increase in longevity. Further fœtalization, on the other hand, will lead to the elimination of more and more of the differentiated characters of the adult. The most outstanding change would be a shift in proportions, for the head would come to represent progressively more of the whole body, the lower limbs progressively less. The brain might even attain the early fœtal proportion of 20 per cent. of the total body weight instead of its present 2 per cent. or so.

There is little doubt that environmental factors have played a part in all this, particularly in the increasing stature and probably in the fœtalization of the skull; for modern white man—who exercises the greatest environmental control—shows both trends most obviously. Such control, which is still in its infancy, thus seems to foster both factors. Future environmental control will probably transcend anything that can be envisaged today and the result should be an intensification of the present tendency towards a compromise between the two extremes described here. This implies only the possibility of an indirect influence on evolution through the environment. However, the ability to influence evolutionary trends by direct interference with the living organism should not be beyond the scope of future technical achievement. The objectives would depend upon the intellectual outlook at the time and the results may be either very poor or very good, although even now it can be seen that those objectives should include an optimum stature, maximum cerebral development and the deferment of maturity for as long as possible. The potentialities of an individual with such cerebral development and a protracted opportunity to explore its possibilities exceed anything at present conceivable.

U.N.E.S.C.O. Programme

SCIENTIFIC APPARATUS INFORMATION BUREAU.

The need for an international non-commercial source of information upon instruments, apparatus, materials and techniques was intensified by the post-war condition of Europe. Not only had the countries of Europe to find their way into unfamiliar sources of supply instead of depending almost entirely upon German equipment and texts, but they knew nothing of the advances which had been made in the war years, especially as regards instruments. UNESCO is therefore at present initiating a *Scientific Apparatus Information Bureau*, or SAIB, of which the chief purpose will be to answer queries concerning scientific and technological equipment for education and research. It is anticipated, in view of unsolicited queries that have already come to UNESCO, that information will be sought by institutions of all ranks from countries in all stages of development—that even the great research centres, though having their own facilities for supply of information, may have an occasional special question. The Bureau will endeavour to cover:

1. The Pure Sciences.
2. The Medical Sciences, including anatomy, surgery, pharmacology, bacteriology, pathology and histology.
3. The Engineering Sciences.
4. The Industrial Sciences, including such subjects as industrial analysis; testing of oils; testing of wax and coal products; testing of paints, paper, plastics, rubber, soap, dyes, textiles; assaying; glass technology; testing of iron, steel and cement; food technology; dehydration and processing.
5. The Agricultural Sciences, including soil science, crop breeding, plant pathology, fertilizers, insecticides and fungicides.

The Bureau will aim to supply information requested about new materials and appliances; such, for example, as the new plastics, beryllium alloys, new magnetic materials, new organic reagents for metal analysis, methods of two-dimensional chromatography, polarographic analysis, radar, electron microscopy, the ENIAC and other calculators, the betatron and synchroton, the radioactive isotopes and associated counting equipment. It is realized that information as to equipment and materials cannot be separated from associated information as to techniques, although the latter is not a primary service of the Bureau.

SAIB is assured of co-operation from the Scientific Instrument Manufacturers' Association of Great Britain, from the Scientific Apparatus Makers of America, and from the various International Scientific Unions. Each of the Unions will be asked to set up a Commission on Instrument Enquiries. Contact is also being made with inter-governmental organizations, such as the International Bureau of Weights and Measures, the International Standardization Organization, the International Commission of Agricultural Industries and the International Institute of Refrigeration. The various scientific societies, research associations, universities and technological associations in different countries are being approached.

SCIENCE CO-OPERATION OFFICES.

The mutual establishment of science co-operation offices by different nations during the recent war represents the fourth stage reached in the history of international co-operation in science. In the seventeenth century the newly founded academies of science appointed foreign secretaries to communicate with observers abroad. In the eighteenth century scientific symposia of international range were held irregularly in the great cities. In the nineteenth century formal international agreements and organization began to appear, beginning with the international chart of the heavens in 1824, and to develop through large international congresses meeting regularly. In the early twentieth century various international unions were established and eventually joined in the I.C.S.U.

The war-time science co-operation offices were not confined to special fields of science; they gave attention mostly to applied science and to social consequences of science; and they were adequately supplied with staff, funds and mechanical aids. On the other hand, they were restricted as to national scope. It will be remembered that the largest offices were the British Commonwealth Scientific Office Washington and the United States Sci Mission in London. Others included the Scientific Missions in London and W the Australian Scientific Research

* Continued from Vol. xi, No. 1, p. 5.

Office in London, and the Office of the Australian Scientific Counsellor in Moscow.

Only one of these offices gave more attention to civil matters, such as agriculture, industry and reconstruction than it did to war science: that was the British Scientific Office in China. The experience of Dr. Joseph Needham, F.R.S., with this office in Chungking has largely inspired UNESCO, in which he is Head of the Natural Sciences Section, with a realization of the value of a chain of science co-operation offices in peace-time. In the "bright" zones—so distinguished with regard to scientific and general cultural development—the functions of co-operation could be performed through the international and other spontaneous associations of scientists, and through various agencies of UNESCO and of the United Nations. The need for special Field Co-operation Offices, covering the whole range of pure and applied science and technology, and linking together the scientists and technologists of far-removed countries with their colleagues in the main centres, lies chiefly in the less advanced regions, where low standards of life are a potential cause of international tensions.

It was decided to establish three offices during 1947—in Latin America, in the Far East and in the Middle East—and a fourth in 1948—in southern Asia. Their chief functions are to establish various contacts and relationships; to act as a clearing house and information centre for the supply and distribution of literature, equipment, information and ideas; to facilitate the outward movement of reports and scientific information from the region; to advise governments, missions and specialized agencies; and to assist in the popularization of science and in the world organization of science with particular regard to the region served. It is felt, for example, that a field office should act as a scientific post office for the interchange of manuscripts and papers—a "department of insufficient address" aiming to ensure that every communication reaches its proper destination, a destination of which the author himself may have only a vague conception.

The Middle East office, established in Cairo in July-August, 1948, operated from the beginning very closely along the lines foreseen. It is staffed by an agricultural chemist from Belgium and a mathematician from Norway—who must deal with all branches of science and technology. They spent their first months in establishing personal relationships with colleagues in other agencies, with the universities and academies, and with government ministries in Egypt, and upon visits to adjacent countries. The Middle East office acts as agent for the International Scientific Unions and is endeavouring to initiate mechanisms for supply of information, books and equipment and for travel of scientists. Guidance has been given, for example, upon orientation of the work of the astronomical observatory, on genetics of malons, on the organization of research, on the placing of optical technicians for experience with Swiss firms, and on exchange of information with Latin America regarding bilharziasis and schistosomiasis. The most spectacular services of the office were performed at the time of the cholera epidemic, in obtaining from America unpublished data for local bacteriologists on copreant bodies in enteric affections, in securing type-culture strains of *B. subtilis* and in supplying samples of benzpyrene.

The Latin American office was established in Rio de Janeiro in April/May, 1947, staffed by a tropical botanist from the United Kingdom and a parasitologist from Greece. It has largely been occupied with the onerous task of preparing the ground for the International Institute of the Hylean Amazon which is being established through UNESCO, and it has therefore had to a large extent to postpone development of the more normal functions of a Field Office. Among important problems brought to its attention, however, has been the possibility of expansion of the cattle industry in the tropics.

The East Asia office was opened in Nanking in November, 1947, staffed by a civil engineer from Czechoslovakia. Its initiation was eased by the fact that Chinese scientists were already accustomed to scientific liaison, through the operations of the Sino-British office during the war. Accommodation was provided by the Academia Sinica. Normal development, however, was temporarily interrupted by the termination of the activities of UNRRA, from which the UNESCO field office took over certain assets and the responsibility of receiving and

distributing some millions of dollars worth of equipment.

It is intended that officers in charge of field co-operation offices shall be from the more developed countries and that they shall build up their staffs from local personnel.

Scientific Abstracting.

In June, 1946, the British Medical Association drew the attention of the UNESCO Preparatory Commission to the situation in the field of medical abstracting, where two new services in English were entering the field simultaneously—*World Abstracts*, published by the B.M.A., London, and *Excerpta Medica*, supported by a group of Amsterdam publishers. As a result, UNESCO organized a series of three conferences, from December, 1946, to October, 1947, which eventually included *Excerpta Medica*, *World Abstracts*, the Bureau of Abstracts (London), *Biological Abstracts* (Philadelphia), the World Health Organization's Interim Commission and the Medical Libraries Association of the U.S.A. Agreements were made by which *Excerpta Medica* proposed to convert itself into a non-profit-making organization so as to assist collaboration; by which *Excerpta Medica* and *Biological abstracts* each considered withdrawing from certain subject fields to eliminate overlap; and by which the organizations were to explore experimentally the possibilities of collaboration by using the same panels of abstractors and by exchanging abstracts.

The Conference recommended the initiation of further conferences by UNESCO for overall development in the field of biology; asked UNESCO to enquire into the demand for abstracting services in languages other than English and into existing facilities for translation; and asked UNESCO to promote the preparation and publication of comprehensive multi-lingual dictionaries of the biological and medical sciences. It also asked UNESCO to set up an Interim Co-ordinating Committee of international non-profit-making abstracting organizations. Acting upon this recommendation, UNESCO called the first meeting of the "Interim Co-ordinating Committee on Medical and Biological Abstracting" in April, 1948, at Unesco House, followed by a meeting of some representatives of the French medical and biological abstracting services in June, 1948. The Interim Committee established an Executive, recommended that the World Health organization and the Food and Agriculture Organization be invited to join in sponsoring its activities, and recommended that the Committee be enlarged to include six other abstracting services or national groups in addition to the four initial members.

In relation to Social Science Abstracting, UNESCO has prepared a preliminary memorandum describing the present state of social science abstracting in various countries. This has been submitted to specialists for comment. The original plan for an expert conference in 1948 has been indefinitely postponed for lack of finance, but a documentary report will be prepared to serve as a basis for a later conference.

To consider scientific abstracting, UNESCO called an Expert Committee which met in Paris in April, 1948. It included Dr. A. King of London as chairman, Professor E. Velander of Stockholm as vice-chairman, Sir Donald Chadwick, Dr. E. J. Crane, Mrs. E. Cunningham, Professor F. Cuta, Dr. F. D. Duyvis and Professor J. Wyart. The Committee also included representatives of the UNESCO Secretariat and observers from the United Nations and from the World Health Organization. Its primary purpose was to discuss arrangements for an international conference to be held later in the year. It was decided to include working scientists as well as abstractors as members of the conference, with social scientists as observers, and to group subject fields as follows:

(*a*) Physics and Engineering;
(*b*) Chemistry, pure and applied;
(*c*) Biology and Medicine;
(*d*) Agriculture.

In the hope of preventing overlapping, approaches were to be made to the I.C.S.U., the International Federation of Documentation, the International Federation of Library Associations and the International Standardization Organization. Among subjects discussed by the Committee were definitions covering indexes of various types; the present scope and quality of abstracting services; the problem of languages; the technique of preparing and issuing abstracts; the relationship between abstracting, indexing and reviewing services; standardization of abstracts; and the effect on

abstracting of new mechanical and electronic devices for classifying information.

UNESCO is planning for a general World Council of Scientific Abstracting Services, in collaboration with other interested bodies. It has funds for the Interim Committee and Expert Committee to be followed by an International Conference in 1948 and is confident of continuing the work in 1949.*

(To be continued.)

Science and Modern Manufacture†

SIR CLIFFORD PATERSON,
O.B.E., D.Sc., F.R.S.

THOUGHTS on the position of science in modern industry and the emphasis that one places on the different aspects of the subject are inevitably drawn from one's own experience. Thinking on this subject is not always sound and realistic. The ideas of the author are based on his observation of events mainly in Great Britain. Some of his remarks may be contentious or may apply more to English than to Australian conditions. One is very conscious of the danger of trying to generalize on a subject in which circumstances rather than principles have so often to dominate decisions. One can only attempt to define the problem, in the hope that if we understand its nature we shall search in the right direction for a solution.

What does manufacturing industry ask of science? The answer, we believe, is scientific service. Above all else, industry needs all the resources of science to be brought to bear upon its manufacturing methods, processes and materials, so that it may fulfil what is surely its first function, that of manufacturing efficiently and effectively the product the purchaser needs. The number of new products and revolutionary schemes which an ordered and efficient industry can assimilate in a year is very limited, but no such limitation applies to additions to knowledge.

If the priority of scientific service is admitted, rather important conclusions follow. Unless an industry has within it men who can formulate its problems scientifically and act for it as interpreters of science, it cannot be scientifically alive and receptive. It cannot make proper use of the results of investigations carried on outside the industry. Modern manufacture needs scientists who will identify themselves with its concerns.

In England much the greater actual volume of industry is carried on by small firms. There are about 400 large and medium firms with worthwhile laboratories and staffs. About £25,000,000 is spent annually within manufacturing industry on scientific effort (excluding routine testing). Those 400 firms represent the volume of British industry which has an increasingly large and efficient scientific service from within itself.

But what about the much larger number of small firms which cannot afford effective scientific facilities? The best of these rely on their wits assisted by the Research Associations. The remainder have only their wits.

To the small firms, the Research Associations are vital as their only source of scientific service. The type of service they need is not reports and advice so much as men to guide them through their technical and scientific problems. The Research Associations are now alive to the need to build up industrial scientific agencies which can help the smaller firms and they are experimenting in this direction, though perhaps in a rather timorous way. The Cotton Research Association is probably the most enterprising and experienced in the matter. The task is most difficult because the manufacturing staffs in small concerns are in their empirical way very capable, and they do not welcome the (to them) rather amateur ministrations of outside scientists.

Perhaps one day an industry consisting mainly of small concerns might maintain collectively an agency of scientific experts who would have a common research laboratory, but who would spend most of their time within the industry, centring their activities in the individual concerns of their clients. Trends in the agricultural field here, and to a lesser extent in England, are along these lines.

This type of research association would be distinct from one which co-operates with an industry already equipped with an internal scientific staff, and which can thus devote itself to the broader background researches required by the industry as a whole.

It is a great advantage to have industrial units each large enough to carry its own well equipped laboratory and a strong scientific team that can maintain direct connexions with world science and keep the firm's product in the van of progress. A large part of the requirements of some products (e.g., those involving mainly mechanical engineering) *can* be fulfilled by first class designers, mechanical engineers and metallurgists. But modern manufacture really requires much more—people whose sole function it is to study the processes and the use of the product.

The outlook of the scientific staff is, and should be, different from that of the factory production staff. The latter must concentrate on securing steady efficient production and are

* Detailed reports of both the medical and the scientific committee meetings may be borrowed from the Commonwealth Office of Education; the latter report covers more than fifty typewritten

† Based on an address given to the Divisions of the Australian Branch, Institute of Physics, 1948.

seldom in a position to scrutinize the industry in a detached way with a view to making changes that will upset carefully established manufacturing practices. There is great value in sympathetic criticism and scrutiny by a scientific group whose outlook favours change and whose intimate associations with industry breeds confidence in their judgements.

The metallurgical and chemical industries in England *must* have within them such scientific resources. The textile industry suffers from having developed horizontally rather than vertically. It has thus been unable to use science effectively because a scientific staff must have experimental control of all the materials and processes of an industry from beginning to end. The Cotton Research Association is doing splendid work towards counteracting this handicap.

It is of vital importance to organize effective liaison between the research laboratory staff attached to a manufacturing concern and the technical staffs of its factories. The General Electric Company, in common with most large manufacturing concerns, consists of a large number of relatively independent and diverse factories, technically and often geographically separated. To fulfil the primary function of service to the individual plants, the internal organization of the laboratories must correspond with the company "set-up", but it must also be flexible enough to allow for such long-term researches as will, in the opinion of the laboratory staff, ultimately benefit their industry.

An intimate knowledge of the existing products and processes in a manufacturing industry is the best source of inspiration for the right sort of long-term, as well as short-term, researches and developments, and prevents expenditure on unnecessary and ineffective experiment.

Solving the difficult problem of welding into a single team a group of raw but enthusiastic scientists and a factory staff with long experience and a just pride in their production skills and achievements depends as much on a study of human nature as upon a technical understanding of the manufacturing processes. It is the essence of successful industrial scientific progress and does much to determine the internal organization of the laboratory. It is a continuing battle, which must be fought in every factory. To lay siege to the good will of the factory production staffs at all levels is an essential and most beneficial part of the training of the laboratory staff.

At Wembley the laboratory staff structure is not organized in terms of physics or engineering or metallurgy, and so on, with a chief physicist, etc., in charge of each such group. It is found that there must be a distinct group of workers (here, mostly physicists, engineers, and chemists) with a group leader for each important section of the company. In addition strong service groups—analytical chemists, metallurgists, X-ray workers and spectroscopists, and statisticians—constitute about 10 per cent. of the scientific staff and join in the specific researches of the other groups as required. The Wembley system is flexible and somewhat informal.

Much help in the guidance of the work of any group is obtained from interlocking meetings attended by representatives from the scientific group and from the individual plant which the group serves. At these meetings the status of products and processes is discussed from the technical and marketing standpoints.

Scientific service should extend to the problems associated with the use of the material or equipment by the purchaser or public. The design of so many products is vitally affected by how they are to be used. Picture the inefficiency and bungling which prevails when the manufacture is content to leave it to others to tell him what to manufacture or is told to do so. Success in the last war was in no small measure due to an enlightened outlook in this respect in most fields.

Many products, particularly those originating with the laboratory staff, should be pre-produced by them, either in the laboratory or in the factory under their technical control, before they are seriously contemplated for production. This is desirable from the point of view of the product, because any serious break away from manufacturing orthodoxy is bound to meet with scepticism, and none but the originators are likely to put so much keenness and determination into making a success of an innovation. The laboratories should be given every opportunity to develop any important new idea.

The try-out unit is also most desirable from the point of view of the laboratories and their staff. The effort actually to "produce" articles for which they themselves take responsibility has a great educative influence, which is sometimes overlooked.

Many problems in manufacturing industry, such as the achievement of uniformity, can usually only be probed by actually making the article regularly over a period of many months, and trying it out in limited use. The methods ultimately used in the factory production of the article will not necessarily be identical with those used in the final laboratory pre-production stage, but most difficulties will have been surmounted by the laboratory staff.

It may be argued that these conceptions of science in manufacturing industry are extravagant. (In the General Electric Company the cost of scientific service amounts to between 1 and 1½ per cent. of turnover.) But if a manufacturing firm is to be really in the van of progress, nationally and internationally, it must have first-class scientific leaders of thought on its staff to act as a sort of scientific general staff.

Secondly, the testing time of every manufacturing industry comes sooner or later, when a new development strikes a devastating blow at its best and most lucrative products. For

instance, in the 1930's the staff at Wembley, backed up by an intimate knowledge of the possibilities of the discharge lamp, dealt the blow to the gas-filled filament lamp, which in the 1920's had seemed assured of its position. Others would have dealt the blow within a year or so, but in competitive industry one must be in a position of awareness to enable one to jump in with weight and effect. The long distance telephone and the steam turbine appear now to be in for a testing time of greater or less severity. For all such emergencies, first-class scientific men, backed by modern scientific facilities, are needed inside industry.

[With great regret we record the death of Sir Clifford Paterson, shortly after his return to England after having spent four months in Australia. He had visited numerous industrial organizations in all parts of Australia and New Zealand and he gave addresses to many scientific and technical bodies in both countries. Sir Clifford was accompanied by Lady Paterson, who always took great interest in his scientific work.

Clifford C. Paterson was born in 1879. After four years of mechanical shop apprenticeship, followed by college education, he had further training as an electrical shop apprentice in Switzerland. For the following eighteen years he was on the staff of the National Physical Laboratory at Teddington, England. In 1919 he was called upon to establish and organize the Research Laboratories at Wembley for the General Electric Company. At the time of his death he was Head of the Laboratories and a Director of the Company. He had a staff of 1,200 at Wembley, to serve a company of 50,000 employees.

Sir Clifford was a Foundation Fellow and Past President of the Institute of Physics and Past President of the Institution of Electrical Engineers of Great Britain and of the Illumination Society of Great Britain. He took a very active part in the work of the International Commission on Illumination, of which he was Honorary Secretary. He was especially interested in the coming of the co-operative industrial Research Associations, having been a member of the Advisory Council of the D.S.I.R. which fathered them and having helped directly in the foundation and running of several of them.]

Correction

The following typographical corrections should be made in the text of the article, *Extension of our Understanding of Protein Function in Living Organisms*, by J. W. H. Lugg, which appeared in this JOURNAL, Vol. 10, No. 5, p. 132:

On page 134 the first sentence under the subtitle "Morphological and Other Considerations" should be changed by substituting the word "of" for the word "or", to read:

> Perhaps the most fundamental problems in present-day biology lie in the concepts of growth and development, of organization and form.

The last sentence of the last complete paragraph on page 134 should read:

> To the hypothetical material substance which underlies the locus the name "gene" is given.

Ernest Clayton Andrews

ERNEST CLAYTON ANDREWS, who died on 1 July, 1948, was born in Sydney in 1870. He entered the University of Sydney in 1891 and came under the spell of the newly-appointed Professor of Geology, T. W. E. David, becoming later one of his most distinguished disciples in the science of geology.

His earliest important contribution to geology was his work on Agassiz's expedition to the South Pacific for the study of coral reefs. He joined the Geological Survey of New South Wales in 1899, and in 1920 was appointed Government Geologist. He was the pioneer of physiographic studies in Australia, on which he published a number of important scientific papers. He was also the author of many publications of the Geological Survey of New South Wales, the greatest of which is his Memoir on the Geology of Broken Hill.

In the course of his geological field work Andrews linked the rocks and soils with the plants which flourished upon them, which naturally led him to take a great interest in the characters and distribution of the Australian forest flora; his observations and studies on such matters were published in a number of scientific papers, the most important of which dealt with the Evolution of the Australian Flowering Plants and the Origin of Pacific Island Floras.

Andrews generously gave much of his time to the advancement of science in Australia on the councils and committees of many scientific bodies. He was a member of the Council of the Royal Society of New South Wales for many years and was President of the Society in 1921. For a period of twenty-five years he was a member of the Council of the Linnean Society of New South Wales, being President in 1937. He was an elective Trustee of the Australian Museum from 1924 to 1948, and was an Honorary Fellow of the Royal Society of New Zealand. On the side of mining geology he was President of the Australasian Institution of Mining and Metallurgy in 1929 and was an Australian delegate to the Second Empire Mining Congress in 1927.

He was a very active member of the Australian and New Zealand Association for the Advancement of Science and took a prominent part in a great number of the meetings of the Association in all States of the Commonwealth and in New Zealand. From 1922 to 1926 he was Honorary General Secretary of the Association. During this period he took a prominent part in revising the Constitution and the present Constitution, adopted at the meeting of the Association in Perth in 1926, is based upon the draft which he made. In 1930 he was President of the Association at the meeting in Brisbane. Andrews was a prime mover in the inauguration of the Australian National Research Council. He was one of the original members and served on the Executive Committee from 1922 to 1942.

His scientific work was carried into a wide field when he attended the first meeting of the Pan-Pacific Science Congress at Honolulu in 1920. There he was elected the Australian representative for the next Congress. This was held in Australia in 1923, when he was one of the four General Secretaries appointed for the organization of the meeting. He was the leader of the Australian scientific delegates to the succeeding Congresses held at Java (1929), Canada (1933) and the United States (1939). He also attended the Congress at Tokyo in 1926 as a delegate of the Australian National Research Council.

In 1927 Andrews was invited to give the Silliman Lectures at Yale University. He received many honours in recognition of his scientific work. In 1915 he was awarded the David Syme Prize and Medal by the University of Melbourne; the Royal Society of New South Wales awarded him the Clarke Memorial Medal in 1928; and the Geological Society of London awarded him the Lyell Medal in 1931. He was Clarke Memorial Lecturer to the Royal Society of New South Wales in 1942 and Mueller Medallist of the Australian and New Zealand Association for the Advancement of Science in 1946. He was elected an Honorary Member of the Washington Academy of Science and of the Geological Society of America and was for many years an Associate Editor of *Economic Geology*.

In addition to his scientific achievements and his devoted work for science, Andrews did much to encourage young scientific workers. He was a very kindly and unselfish man, who endeared himself to his friends and colleagues in all walks of life. In the latter years of his retirement he led a quiet life and devoted much of his thoughts to the spiritual side of living. As a product of his meditations in this period he published two small books, *The Increasing Purpose* in 1939, and *The Eternal Goodness* in 1948. The latter, dedicated to his wife, appeared a few days before his death on 1 July, 1948.

Andrews's work will for all time hold an honourable place in the annals of Australian science.

LEO A. COTTON.

A Method for the Compilation of Regional Soil Maps

ROBERT SMITH.*

THE compilation of soil maps which will indicate fairly accurately the distribution of soils over a whole province or region is a project to which soil surveyors have given considerable thought. The kind of map required is one which is drawn to a scale of approximately three miles to the inch and which can be used as a base map for general land use studies. Studies of whole agricultural industries, of the incidence of soil erosion, of the maintenance of soil fertility, are general examples of this type of project. The mapping units chosen must be well defined and the soil boundaries shown on the map must be expressed with reasonable precision. To obtain this control, soils must be grouped on the basis of their parent materials; that is, soils formed from laterite are grouped together; soils formed from the granite-gneiss complex make up another group, and so with other soil-forming materials. The grouping of soils in relation to climate, on the other hand, results in very large mapping units which exhibit fundamentally different characteristics, but the boundaries of which are diffuse. Both Prescott's soil map of Australia (1944) and Teakle and Gardner's map showing soil and ecological regions of Western Australia (1938) exhibit this characteristic of diffuse boundaries to a marked degree. After allowing for the very broad scale of these compilations (approximately 150 miles to the inch) field workers find great difficulty in determining just where one zone or region gives way to another. For this reason the grouping of soils on the basis of their parent materials is preferred to the climatic grouping for the type of compilation under discussion.

THE WESTERN AUSTRALIAN AGRICULTURAL REGION.

The agricultural areas of Western Australia provide an example of a large compact area of land for which broad-scale soil maps are urgently required. A slightly convex line drawn from the mouth of the Murchison River to the vicinity of Israelite Bay at the head of the Great Australian Bight includes all the actual and potential agricultural land in south-western Australia. The area included in this large tract is in the vicinity of 66,000,000 acres or approximately 100,000 square miles. A considerable amount of soil survey work has already been carried out: officers of the Department of Agriculture have surveyed in detail one and a quarter million acres of land and have covered a further four million acres with reconnaissance traverses. This land is largely in the eastern section of low rainfall. In the higher rainfall areas, the Forests Department has carried out in great detail soil surveys of selected areas, both in pine plantations and in indigenous forests. The total area surveyed is 24,000 acres. More recently the Division of Soils, Council for Scientific and Industrial Research, has carried out soil surveys in connexion with War Service Land Settlement. The total area surveyed is 240,000 acres. Much of the material from all surveys by these authorities has not been published and is not available to research and extension workers. At the present time, requests for soil surveys

* Council for Scientific and Industrial Research Soils Division Regional Officer. A paper read at the twenty-sixth meeting of the Australian and New Zealand Association for the Advancement of Science, Perth, Western Australia, 1947.

far outweigh the capacity of the available staff, both State and Commonwealth. Surveys are requested in connexion with widespread problems such as salinity on existing farm-lands as well as investigations of undeveloped Crown Lands with a view to land settlement.

WESTERN AUSTRALIAN REGIONAL MAPS.

The purpose of this paper is to present the outline of a method that is being used in Western Australia for the production of regional soil maps. The type of map produced will be familiar to many readers, as one compilation, "Soil Formations of the Perth Area", was reproduced in the Handbook of Western Australia (1947).

The method can be carried out in three steps:

(1) The study of broad soil formations over the area selected. Generally the area selected coincides with a map of the Lands Department 1 mile = 1 inch series which covers approximately 950 square miles.
(2) The survey of soil types over small selected areas covering the broad soil formations. Each "spot" survey covers approximately five square miles and with six such "spots" to the sheet a total of thirty square miles is surveyed in considerable detail. This is approximately 3 per cent. of the total area.
(3) From a study of the soil pattern revealed in the "spot" surveys associations of soil types are recognized. Further traverses approximately one mile apart are then made over the whole area of the sheet for the purpose of mapping these associations which are shown on the final map. The map showing associations of soil types is, of course, merely a refinement of the original map showing broad soil formations.

The soil association is a broad scale mapping unit which has been used in Canada and the U.S.A. as well as in Australia. It has been defined as "a group of soils, with or without common characteristics, geographically associated in an individual pattern". Another definition refers to it as "a particular landscape pattern, defined according to the character of the soils that compose it and the pattern of their distribution". Overseas use of this term requires closer definition and control. Australian usage of the association has been as an association of soil types, the boundaries of which can be accurately defined.

A MAPPING PROGRAMME FOR THE WESTERN AUSTRALIAN AGRICULTURAL REGION.

This area of approximately 100,000 square miles embraces approximately 130 sheets of the Lands Department 1 mile = 1 inch series. At the present rate of working it will take about thirty years to produce broadscale soil maps of each sheet. Priority will be given to soil surveys that are specifically requested by State and Commonwealth authorities, but an attempt will be made to round off each area where such surveys have been carried out.

Results of surveys are being published in the C.S.I.R. Bulletin series as associations of soil types are mapped over the whole sheet. When a number of sheets in a particular area is completed a further publication will integrate the results obtained. In this way all survey data will be systematically exploited and the results passed on to research and extension workers with a minimum of delay.

At the present time, maps of the following Land Survey sheets are being compiled by the Division of Soils:

Sheet No.	*District.*
440, 441 ..	Margaret-Augusta.
443, 444, 445	Frankland River.
416	Kojonup.
1	Perth.

FIELD USE OF THE REGIONAL MAPS.

The completed maps showing associations of soil types are for use by research and extension workers. The scale which has been selected is such that, although the area covered is large, the soil pattern can be related to individual locations and individual farms. Whether the map will provide sufficiently specific information in cases of reference will depend partly on the nature of the investigation and partly on the soils background of the investigating officer. Officers of Soils Division consider that much greater use can be made of soil maps if research and extension workers using them are given a short but basic training in methods of soil classification and soil mapping.

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Zoological Nomenclature

AT the meeting of the International Congress of Zoology held in Paris in July, 1948, important and far-reaching decisions were taken with regard to zoological nomenclature. The whole of the international law on the subject is to be codified, obscurities removed and many provisions added on subjects not previously subject to regulation. Prior to the meeting, the International Commission on Zoological Nomenclature had engaged in extensive and world-wide consultations; during the Congress all members had access to the discussions of the Commission and the scheme finally adopted was approved unanimously by the Congress Section on Nomenclature and by the plenary session.

The Commission has been enlarged so that zoologists of any country in which a considerable body of zoological work is being performed may have direct representation upon it. The Commission may itself call into membership leading specialists in particular fields irrespective of country. Machinery has been provided for consultations with the leading scientific institutions in any country in regard to the selection of its representatives. The standard procedures of the Commission have been reformed so as to prevent unreasonable obstruction by individuals and so as to enable decisions to be reached comparatively rapidly. It is hoped to promulgate the decision on any question within eighteen months of the date of application.

The existing law as contained in the *Règles Internationales de la Nomenclature Zoologique*, are substantially as adopted at the Congress in Berlin in 1901. The object of current reforms is to clarify obscurities in the text, to make the *Règles* more comprehensive by introducing provisions on questions not hitherto included and, where necessary, to change the *Règles* to bring them into harmony with the general wish.

A large part of existing law is not in the *Règles* themselves but in "Opinions" rendered by the International Commission acting in the judicial capacity entrusted to it by the Congress at Boston in 1907. The complex body of case law that has thus grown up over the last forty years has made the tasks of zoologists difficult. The decisions hitherto embodied only in the "Opinions" are now to be incorporated in the *Règles*. Future decisions of the Commission in particular cases are to be recorded in special schedules attached to the *Règles*. Those on matters of principle will be issued as *Declarations*, with the idea of their incorporation in the *Règles* after approval by the next Congress. Those on individual cases will be issued as *Opinions*, to be inserted in the appropriate Schedule of the *Règles* after the next Congress.

The highly technical task of preparing a substantive text giving effect to the changes now determined has been entrusted primarily to skilled jurists. Points at issue will be submitted to a special committee consisting of the Secretary, Mr. Francis Henning (United Kingdom), Dr. van Straelen (Belgium) and Professor Robert H. Usinger (U.S.A.). The *Règles* in their amended form will come into operation immediately they are promulgated. In the meantime, the *Procès Verbaux* of the Commission will be published in its *Bulletin of Zoological Nomenclature*.

In general it will be found that, in order to ward against the risks involved in retroactive legislation, the provisions relating to names already published are simpler and less rigorous than those to be applied to names published in the future. Thus, whereas workers giving new names will have at their disposal rules which are simple, clear and easy to operate, the position as regards existing names—especially those published before the introduction of the *Règles* in 1901—will necessarily be more complicated. It is hoped, however, that as regards generic names the difficulties will be largely overcome by a rapid and substantial extension of the *Official List of Generic Names in Zoology*, for it has now been agreed that a name once placed on this *List* is not to be changed for any purely nomenclatorial (as contrasted with taxonomic) reason, without the prior approval of the Commission.

A similar provision has been made in regard to the trivial names of species: for these also there has now been established an *Official List* of names which are not to be changed for purely nomenclatorial reasons without prior approval of the Commission. The establishment of these two lists makes it possible for specialists in any group to concert proposals to the Commission for the insertion on the *Official Lists* of the names of the genera and species in their group and thereby to protect those names from changes for any reason other than taxonomic considerations.

It had been decided at the Congress held at Lisbon in 1935 that detailed study should be undertaken on two important questions of nomenclature which had been a cause of difficulty for many years. In each case the report submitted to the Paris Congress provided the basis for an agreed settlement. The first was concerned with the meaning of the expression "*Nomenclature Binaire*" as used in the *Règles*. It was agreed to substitute the term "*Nomenclature Binomiale*", subject to the incorporation of safeguards for generic names published by "binary" though not binomial authors. The second question was concerned with the nomenclature of forms of less than subspecific rank, a problem on which no provision had been made in the *Règles*.

It was decided at the Paris Congress that similar reports should be prepared for submission to the next Congress in regard to other difficult problems, including (1) the treatment of Family names; (2) the nomenclature of Orders and higher groups; (3) the rules which should govern the emendation of names; (4) the problems presented by the demand for the recognition of "neotypes". The Paris meeting of the Commission was faced with heavy arrears of applications submitted for decision since the beginning of the war, but on almost all cases it reached decisions which will be promulgated shortly.

Zoologists should now have a system of law which will be easy to operate and will ensure uniformity and stability. They are also assured of a central authority for nomenclature which will be more representative and international than before and should be capable of efficient service of high value. Further information may be obtained from the Secretary of the International Commissio on Zoological Nomenclature, Francis Hen 83 Fellows Road (Garden Flat), N.W.3, England.

Recent Research

WESTERN AUSTRALIAN GEOLOGY

The elucidation of the geology of the western third of the Australian continent by a handful of geologists is necessarily slow, so that it is pleasing to record the appearance of several geological papers of Australia-wide interest in a recently published volume of the *Royal Society of Western Australia* (Volume XXXII, for 1945-46, issued July, 1948).

Cretaceous stratigraphy in the almost inaccessible country near the mouth of the Murchison River is described by E. de C. Clarke and C. Teichert (*Cretaceous Stratigraphy of Lower Murchison River Area, Western Australia*). Over forty years ago it was known that sedimentary strata occurred in this area, but it was not until 1929 that a typical Upper Cretaceous fauna, including *Uintacrinus* and *Marsupites*, was identified by Mr. L. Glauert. During a short field trip in 1944 Professor Clarke and Dr. Teichert were able to show that the Cretaceous here consists of a series, named the Murchison House Series, the lower beds of which are sandstones (the Tumblagooda sandstones over 400 feet thick at the base), and the upper bed shales (glauconitic, Alinga Beds, 10-75 feet thick), chalk (Toolonga Chalk, 35-120 feet thick and correlated with the Gingin and Dandaragan chalk to the south), and upper light green glauconitic shales (Second Gully Shale, 92+ feet). The glauconitic shales appear to be the equivalents of the Upper and Lower Greensand at Gingin. Interesting suggestions are made concerning the distribution of the Cretaceous in the coastal belt between latitudes 22° and 31½° S.

A contribution to the knowledge of Miocene sedimentation is made by E. de C. Clarke, C. Teichert and J. R. H. McWhae (*Tertiary Deposits near Norseman, Western Australia, with an Appendix by Irene Crespin*). Norseman is situated in Pre-Cambrian gold-bearing country about 100 miles north of Esperance on the shores of a large salt "lake". Fossiliferous deposits in the form of an opalized beach containing marine shells were described as early as 1906 by W. D. Campbell, and since that time small isolated outcrops of spongolite have been found in several localities both north and south of Norseman. The spicules of the spongolite were described by Hinde in 1910. In this paper detailed descriptions of the fossiliferous localities are given, the following rock types being identified and mapped: spongolite, unfossiliferous dolomite, fossiliferous limestone. From a study of the Bryozoa in the rocks of the opalized sea beach and in some of the limestones, Miss Crespin considers that they are of middle Miocene age and tentatively suggests correlation with the Balcombian deposits in Victoria and in South Australia. As both the Eucla limestone of the Nullarbor Plain and the Plantagenet Beds (west of Ravensthorpe) are of Miocene age, it is probable that these Norseman sediments are remnants of a sheet of sediments which must once have covered a considerable area of the southern part of the Western Australian shield.

The peneplained Pre-Cambrian surface of the southern half of Western Australia has along a considerable distance of its western scarp-like edge the appearance of a fault, but recent detailed mapping in several areas near Perth has convinced Dr. R. T. Prider that there is no positive evidence for the existence of the Darling Fault (*The Geology of the Darling Scarp at Ridge Hill*). He bases this conclusion on detailed examination of the structure of the Pre-Cambrian in the vicinity of Ridge Hill and Armadale, together with an explanation of the origin of a ferruginous sandstone, conglomerates, sandstones, yellow sand, and laterite (high and low level). The examination of these rocks follows well known methods of sedimentary petrology such as mechanical analysis, mineralogical examination and chemical analyses. The degree of sorting of the sands, the roundness of the component grains, and a description of their surface texture provide ample evidence for his conclusions. At the Perth meeting of the Australian and New Zealand Association for the Advancement of Science, Dr. Prider arranged a field excursion to Ridge Hill and this paper will be read with much interest by those who visited this area. The paper serves as an example of the successful elucidation of a geological problem by a combination of the methods of petrology and sedimentary petrology.

Australian and New Zealand Association for the Advancement of Science

HOBART MEETING

ARRANGEMENTS and programmes for the Hobart meeting of A.N.Z.A.A.S. are now well advanced and there are indications that it will be largely attended. The Accommodation Committee has so far secured 600 reservations for visitors, and many others have made private arrangements. Although all hotel accommodation is now booked, it is expected that all members wishing to attend the meeting can be accommodated, although it will be necessary for them to accept lodgings in private homes. There is a great shortage of single rooms, and all additional bookings will now be shared rooms.

The President Elect, Dr. A. B. Walkom, has selected as the title for his presidential address "Gondwanaland, a Problem in Palæogeography". A discussion is being arranged on "The Place

of the Australian National University in the Academic Structure of Australia", to be opened by Professor D. B. Copland. Professor Copland is also to deliver a public lecture on the subject "Australia, 1949; the Basis of Economic Prosperity". A new session has been organized on the social and international relations of science with the subject "Is there a Scientific Approach to Problems of Human Conflict?" as discussion theme.

Section B (Chemistry) has so far the heaviest programme of technical papers, and concurrent sessions are being arranged throughout the meeting. Symposium topics include Electro-Chemistry, Chemical Education, Chemical Kinetics, Chemistry of Minerals, Modern Techniques of Analytical Chemistry, and Drugs. In addition, miscellaneous papers in the fields of Organic Chemistry, Analytical Chemistry, Biochemistry, and Chemical Engineering are included.

Section C (Geology) is arranging symposia on the following subjects:

"Teaching of Geology and Geophysics",
"Some Aspects of Granitization",
"Structure, Stratigraphy, and Ore Deposits of the West Coast of Tasmania",
"Applications of Geochemistry",
"The Siluro-Devonian Boundary in Australia", and
"Evidences of Eustatic Changes of Sea Level".

Section H (Engineering and Architecture) has built its programmes around the topics

"Hydro-Electricity",
"Town, Country and Regional Planning", and
"Building Research".

The medical sections (I and N) have combined for a joint meeting for the whole conference. This joint section has adopted the discussion theme "The Control of and Resistance to Infection". Dr. Burnet's presidential address is on "The Nature of Immunity". This will be followed by a symposium on the bacteriological and physiological aspects, a session on chemical aspects, a session on experimental research aspects, and a final session on national health aspects.

Section J (Education, Psychology and Philosophy) has a syposium on "Art in Education". The section is also arranging a session on Speech and Speech Therapy.

Section K (Agriculture and Forestry) has found it desirable to split into two sub-sections for the greater part of the meeting, one subsection being devoted primarily to agricultural problems, and the other to forestry. The agricultural sub-section is arranging symposia on the problems of pasture production, soils, horticultural problems and livestock problems, the latter in conjunction with Section L (Veterinary Science).

Section P (Geography and Oceanography) have arranged a session on Climatology, and have joined with Sections G, K, and C in a number of other symposia. A large number of unclassified papers are included in the programmes of the sections mentioned above, and other sections not mentioned.

The demand for excursions is proving very much heavier than usual. The post-sessional general tour of Tasmania lasting seven days had originally been limited to twenty-four people, but already eighty bookings have been received, and the excursion has been increased to run in four divisions. It will not be possible to extend beyond this limit. Likewise the post-sessional geological excursion also overflowed and has been broken into four divisions with different bias. Altogether, some thirty-seven excursions have so far been organized, and a considerable proportion of these have already been booked out. Where possible, the Local Committee has extended excursions to meet the demand of visiting members, but limitations of accommodation and transport have set upper limits to such extension.

Further details of the meeting can be obtained from the Local Secretaries:

New South Wales: Professor N. A. Burges, M.Sc., Ph.D. (Cantab.), F.L.S., Science House, 161 Gloucester Street, Sydney.

Victoria: E. R. Pitt, B.A., F.L.A., c.o. C.S.I.R., Information Service, 425 St. Kilda Road, Melbourne.

South Australia: R. S. Burdon, D.Sc., The University of Adelaide, Adelaide, S.A.

Western Australia: Professor A. D. Ross, M.A., D.Sc., F.R.S.E., F.R.A.S., F.Inst.P., University of Western Australia, Nedlands, W.A.

Queensland: Professor D. A. Herbert, D.Sc., University of Queensland, Brisbane, Queensland.

New Zealand: Gilbert Archey, O.B.E., M.A., D.Sc., F.Z.S., F.R.S.N.Z., Auckland Museum, Auckland.

Australian Capital Territory: C. Barnard, D.Sc., Box 109, Canberra.

Tasmania: Professor S. Warren Carey, D.Sc., M.(Aust.)I.M.M., University of Tasmania, Hobart.

News

Agriculture Conference in Australia, 1949

The 1946 British Commonwealth Scientific Official Conference resolved that a Specialist Conference be held with the major objective of exploring problems connected with the integration of the three main branches of agricultural science—soils, plants and animals—to be the first of a series of Specialist Agricultural Conferences. Arrangements have been made to hold the Conference in Australia, commencing with sessions in Adelaide from 22 to 31 August, 1949. After a twelve-day tour through south-eastern Australia, the final sessions will be held in Canberra on 13, 14 and 15 September. The theme of the Conference will be *Plant and Animal Nutrition in relation to Soil and Climatic Factors*. The primary object will be to focus attention on the principal gaps in our knowledge of the subject and on the main problems requiring attention.

Membership of the Conference will be limited to research workers active in the fields under discussion, the official members comprising about

fifty delegates from the various countries of the British Commonwealth. Papers, however, will be accepted from non-delegates, and a limited number of observers will be admitted. Such papers should be under one of the three headings—"Effects of Specific Soil and Climatic Factors on the Nutrition of Plants"; "Nutritional Problems of the Animal as determined by Plant and Soil"; "Influence of Plant and Animal on Soil Fertility". They should not review present knowledge other than incidentally, in view of the fact that the first session of the Conference will be devoted to papers from official delegates only, upon a "Review of Present Knowledge of the Climatic and Soil Factors affecting Nutrition of Plants and Animals".

The organization of the Conference is in the hands of the C.S.I.R. and the expenses of delegates during the inter-session tour only will be borne by the Australian Government. Further information may be obtained from the Secretary of the Conference Committee, Specialist Agricultural Conference, c.o. C.S.I.R., 314 Albert St., East Melbourne, C.2, Victoria. Papers submitted for the Conference Sessions should reach the Secretary by the end of January, 1949.

Tropical Production of Vegetable Seed

When normal sources of vegetable seed were cut off by war, an examination was made of the possibility of producing seed for crops of temperate regions by growing them in tropical regions. It was found that little was known as to methods of production of vegetable seed in the tropics. At the request of a Seed Conference held in East Africa in 1944, the Commonwealth Bureau of Horticulture and Plantation Crops sent a questionnaire to all likely tropical regions. The replies have been summarized by the Bureau in its Technical Communication No. 19, *Seed Production of European Vegetables in the Tropics*. It is found that seeds of certain vegetables may be successfully produced in certain regions, and produced more quickly than in temperate regions. The bulletin also covers indigenous and naturalized tropical vegetables used in particular regions. The concluding section gives suggestions for research into such matters as the inter-relationships of altitude, temperature and length of day, and into the use of tropical locations to speed up the breeding of plants. It indicates the wide field open for the development of varieties of vegetables suitable to tropical climates. Copies of the publication may be obtained from The Liaison Officer, Commonwealth Agricultural Bureaux, 314 Albert Street, East Melbourne, C.2, Victoria, at a price of 2s. 6d.

C.S.I.R. Information Service

The Information Service of the Council for Scientific and Industrial Research is now located at the Head Office, 314 Albert Street, East Melbourne, C.2, Victoria. The telephone is JA6611 and the Officer in Charge of the Service is Mr. C. M. Gray.

Varieties of Herbage and Fodder Plants

Bulletin No. 39 of the British Commonwealth Bureau of Pastures and Field Crops is a descriptive catalogue of *Five Hundred Varieties of Herbage and Fodder Plants*. For each variety, details are given of the origin, the authority responsible for development, the characteristics, adaptation, use and certification, together with notes on the market for seed. Species are grouped alphabetically and varieties are grouped according to the country of origin or use. Australian coverage includes, for example, fifteen varieties of feed oats and eighteen of fodder maize, together with recognized pasture plants such as the seven commercial strains of subterranean clover. As might be expected in a first edition of such a work, descriptions are not all of uniform degree of detail and coverage of all species in all countries has not been achieved. The index provides valuable access to fuller information. The availability of varieties useful for breeding from overseas or local sources may readily be determined from the Bulletin, with their genetic characters. Copies may be obtained from The Liaison Officer, Commonwealth Agricultural Bureaux, 314 Albert Street, East Melbourne, C.2, Victoria, at a price of 18s. 9d.

Study Year Scheme

Last year the West Australian Association of University Women inaugurated a scheme whereby a British woman graduate could be given a year in Australia to study and to recuperate from the effects of the war. Miss Audrey Stratford, B.Sc., lecturer in charge of Physiology at the London Polytechnic, and Honorary Secretary of the London Association of University Women has been chosen as the recipient of this benefit. She will study "The Effects on Skin Circulation of Acclimatization to High Temperatures and Conditions of Drought".

"Journal of Sedimentary Petrology"

Professor W. H. Twenhofel, University of Wisconsin, Madison, is editor of the *Journal of Sedimentary Petrology*, a publication of the Society of Economic Palaeontologists and Mineralogists which is a division of the American Association of Petroleum Geologists. He has intimated that papers from Australian workers in this or allied fields will be welcome. The Journal contains short articles on various aspects of sedimentary rocks: mineralogy, mechanical composition, stratigraphy, etc. As the publication of accepted papers is usually within six months to a year from the time of dispatch from Australia, and as reprints are available at a reasonable cost, the publication in this Journal of investigations by Australian workers would ease the present difficulties and delays of publishing in the established journals of Australia.

Importation of Books from U.S.A.

The Department of Trade and Customs has arranged for an increased allocation of American dollars for the purchase of scientific and technical books. The fixed annual amount is divided into four equal quarterly portions: if a quarterly quota is not completely expended

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

October, 1948

EDITOR: N. H. WHITE, Faculty of Agriculture, Sydney University, Sydney.

All communications concerning abstracts should be addressed to the Editor.

Vol. 27 **No. 2**

CHEMISTRY.
(Continued.)

14650. **Reuter, F. H.** The Alkaloids of Very Bad Australian Grown Tobacco. *J. Aust. Chem. Inst.*, xv, 1948, 266.—The finely powdered tobacco was extracted with aqueous ammonia and benzene and the alkaloids separated by fractional distillation and precipitation. There was no evidence that bad smoking tobacco could be attributed to the presence of substantial amounts of subsidiary alkaloids.

14651. **Simmonds, D. H.** Isotopes as Indicators in Biochemical Research. *J. Aust. Chem. Inst.*, xv, 1948, 13.—A review of the principal methods of isolating and estimating stable and radio-active isotopes. Twenty-six references.

14652. **Simmons, L. M.** The Mechanism Underlying the Formation of Aqueous Negative Binary Homoazeotropes. *J. Proc. Roy. Soc. N.S.W.*, lxxx, 1946, 196.—It is suggested that the boiling point of solutions in water of soluble electrolytes is a function of both the ions and the molecules present. The ions raise the boiling point of the solution above the boiling point of pure water, whilst the molecules raise or lower it according to whether the boiling point of the pure electrolyte is above or below 100° C. As the concentration of an aqueous solution of a strong volatile acid is increased, the boiling point will fall when the effect of the increasing quantity of undissociated molecules is greater than that of the ions. A weak electrolyte in aqueous solution is insufficiently dissociated to produce a detectable boiling point maximum unless the boiling point of the pure electrolyte is very close to 100° C. The boiling point of an aqueous homoazeotrope of a monobasic acid thus appears to be an undetermined function of the boiling point of the pure acid and the strength of the acid at the concentration of its aqueous homoazeotrope. Fixteen references.

14653. **Stokes, R. H.** Modern Experimental Techniques in the Measurement of Vapour Pressures of Aqueous Solutions. *J. Aust. Chem. Inst.*, xv, 1948, 24.—A review of methods of accurate measurements of vapour pressures. Nine references.

14654. **Sutherland, K. L.** The Determination of the Surface Energies of Solids. *J. Aust. Chem. Inst.*, xv, 1948, 268.—A review of methods, results and theories. Sixty-five references.

14655. **Trautner, E. M., Neufeld, O. E., and Rodwell, C. N.** The Titration of Hyoscine, Hyoscyamine and Atropine with Picric Acid in Chloroform. Separation and Fractionation of the Picrates. *J. Aust. Chem. Inst.*, xv, 1948, 55.—Hyoscine, hyoscyamine and the related bases can be accurately titrated in chloroform solution using dimethyl-amino-azo-benzene as indicator. However, hyoscyamine and atropine picrates are very soluble in chloroform, whilst hyoscine picrate is only sparingly soluble and is precipitated completely by the addition of ether, benzene or petroleum ether. A procedure is given for the approximate determination of 10–90% hyoscine in chloroform-trichlorethylene solution, involving titration with picric acid followed by separation of the hyoscine picrate.

14656. **Trautner, E. M., and Polya, J. B.** Notes on a Variation of the Schotten-Baumann Reaction. *J. Aust. Chem. Inst.*, xv, 1948, 52.—The acid to be esterified is treated in petroleum ether with thionylchloride and the resulting acid chloride poured into a methanol solution of magnesium methylate at 40–50° C. After keeping at this temperature for one hour, the mixture is allowed to stand overnight. After acidification and dilution with water the ester is extracted with ether.

AGRICULTURE (see Vol. 26, No. 6.)
(Continued.)

2. CROPS, PASTURES AND CROP PRODUCTION.

14657. **Ament, B. D.** The Way to Better Pastures in the Central West. *N.S.W. Ag. Gaz.*, lviii (7), 339–343; (8), 403–408; (10), 521–523; (11), 585–588, 1947.—Main benefits of pasture improvement discussed under headings of soil fertility maintenance, soil erosion control, influence of carrying capacity and weed control. Recommended pasture mixtures and notes on species. Establishment and management and seed production.

14658. **Anon.** Experimental Work and Results, State Research Farm, Werribee. *J. Agr. Vic.*, xlv (8), 337–353, 377–387, 392, 1947.—A description of the scope of the farm and the results of experimental work with the breeding of cereal varieties, fertilizers, rate of seeding, cereal diseases, crop

rotations, green manuring, flax, field peas, weed control.

14659. **Anon.** Div. of P.I. The Growing of Celery. *N.S.W. Ag. Gaz.*, lviii (1), 3–8.—Methods for production of high-class celery in N.S.W. described.

14660. **Anon.** *Ag. Gaz. N.S.W.*, lix (1), 12.—Cabbages are very hardy and can be grown successfully in most parts of the State. They are treated as spring and summer or winter crops, irrigated or non-irrigated according to climate. Soil and climatic requirements, cultural methods, harvesting, marketing, varieties and cabbage seed production are described.

14661. **Anon.** The Growing of Sprouting Broccoli. *N.S.W. Ag. Gaz.*, lviii (11), 600–602, 1947.—The vegetable is increasing in popularity. Soil and cultural requirements are similar to those for cauliflower. Details of manuring, cultivation, harvesting, marketing, diseases and pests.

14662. **Anon.** Great Lakes Lettuce—A Useful Imported Variety. *N.S.W. Agr. Gaz.*, lviii (2), 61.—Variety suitable for summer cultivation, particularly in inland areas. It is not prone to "bolting."

14663. **Anon.** Spray Residue on Tomatoes—Acid Dip Method of Removal. *Ag. Gaz. N.S.W.*, lviii (8), 409–410, 416, 1947.—Tomatoes placed in dipping cases and immersed in diluted HCl for 1–1½ minutes, then into lime bath. Convenient method for farmers described.

14664. **Clydesdale, C. S., and Burns, S. G.** Linseed Growing. *Q. Ag. J.*, lxvi (3), 133–137.—A long fallow is essential for the growing of linseed on the Darling Downs. Method of seeding, harvesting, marketing and varieties are described. The need for dusting to control the corn-ear worm is discussed.

14665. **Clydesdale, C. S.** Canary Seed. *Q. Ag. J.*, lxvi (1), 5–6, 1948.—Harvesting of seed has proved a useful source of revenue in wheat lands of the Darling Downs. Methods of soil preparation, seeding, grazing and harvesting are described.

14666. **Cook, L. J.** Baking Quality of Wheat Varieties. *S.A. J. Ag.*, li (4), 174–177, 1947.—A summary of the quality tests being conducted with wheat varieties in South Australia. The new varieties Scimitar, Dirk, Warigo, Ridley and Javelin are generally superior to older commercial varieties.

14667. **Curteis, W. M.** The Growing of *Nicotiana rustica*. *N.S.W. Ag. Gaz.*, lviii (9), 451–452, 1947.—The cultivation of *N. rustica* is being attempted in Australia as a source of supply of nicotine sulphate. Yields of up to 5,000 lb. per acre were obtained in N.S.W. Contract price is 11d. per pound of dry leaf. Fertile soils are required. Cultural methods are similar to those for tobacco.

14668. **Dickenson, H. R.** The "Kinburn" Pasture Plots, Cressy—Report of Ten Years' Trials. *Tas. J. Ag.*, xix (1), 1948, 3–7.—The results from experimental grazing plots laid down in 1937 of temporary pasture plots are discussed. The application of molybdenum has proved most promising.

14669. **Donald, C. M.** Competition between Pasture Species, with Reference to the Hypothesis of Harmful Root Interactions. *J. C.S.I.R.*, xix (1), 32–37.—Experiments with associated pairs of pasture plants did not produce any evidence of harmful root interaction.

14670. **Elliot, H. G., and Gardiner, C. A.** Yarloop (White Seeded) Subterranean Clover. *J. Agr. W.A.*, xxiv (3), 1947, 228–230.—Description and method of establishment of this new commercial strain.

14671. **Ferguson, W. G.** Irrigation of Lucerne in Queensland. *Q. Ag. J.*, lxv (1), 1947, 46–51.—Irrigation of lucerne in Queensland is restricted mainly to the S.E. portion of the State. Autumn seeding on a well-prepared porous alluvial soil. Methods of weed control, irrigation, haymaking and renovation. The irrigated stand lasts 5–10 years.

14672. **Graham, T. G.** Activities of the Bureau of Tropical Agriculture. *Q. Agr. J.*, lxvi (2), 1948, 69–81.—The pasture development work on the South Johnstone station is described. Chief attention has been given leguminous plants and Centrol has been very promising. Sarawak bean, Desmodium and Stylo have given good results, but Calopo has been disappointing. Various grass-legume mixtures are under test. *Paspalum scrobiculatum* is promising.

14673. **Godden, A. T., and Loveridge, J. A.** Chain Wires for Planting out Row Crops. *N.S.W. Ag. Gaz.*, lviii (12), 1947, 627–628.—Measured "links" of 16-gauge wire are used by vegetable growers in the Central Tablelands to attain accuracy in planting out.

14674. **Harper, R. S.** "Tatinter"—A New Victorian Tomato Suitable for Processing and Marketing. *J. Agr. Vic.*, xlv (11), 519–524.—The variety was released in 1944. It is a mid-season variety suitable for northern Victoria and is grown for factory and market. Dwarf or semi-dwarf in habit, round flattened large fruit. A detailed description is given of this promising variety.

14675. **Hatt, H. H., and Hillis, W. E.** The Manna of *Myoporum platycarpum* R.Br. as a Possible Commercial Source of Mannitol. *J. C.S.I.R.*, xx (2), 1947, 207–224.—A single tree may exude 11 lb. of mannitol per year, which is a yield comparable with those of rubber and turpentine trees. Method of isolation of the mannitol from the exudate is described. The tree grows in semi-arid areas and the collection of manna may be a commercial proposition, particularly if the trees could be artificially incised to produce the exudate.

14676. **Hope, R., and Giles, J. E.** Rock-melon Variety Trials in the Mildura District. *J. Agr. Vic.*, xlv (12), 1947, 557–560.—A variety trial was carried out in 1945–46 in the Mildura district, where rock-melons yield very well. The trials indicated the superiority of strains of Hale's Best. Because of considerable variation in this variety there is need to develop pure seed of superior strains.

14677. **Hughes, C. G.** The Introduction of Badila Cane into Queensland. *Q. Ag. J.*, lxvi (3), 1948, 150–154.—An historical account.

14678. **Kershaw, C. J.** Celery Trials. *Tas. J. Ag.*, xvii (4), 319–326.—Recommendations made regarding cultivation of celery on Mowbray Swamp area.

14679. **King, N. J.** Velvet Beans for Green Manuring. *Q. Ag. J.*, lxvi (3), 1948, 148–150.—Varieties of Velvet Bean were tested at Bundaberg in the 1946–47 season and gave promising results in comparison with the Poona Pea.

14680. **Ludbrook, W. V.** A Yield Trial of Top Crosses between a Victorian Strain of Funk's Yellow Dent Maize and Twelve American Inbreds. *J. A.I.A.S.*, xii (4), 139–141.—Top crosses from two of the inbreds gave substantial increases in yield. The method used may be a possible substitute for a full-scale programme of raising hybrid seed which is hardly justified in view of the small area grown.

14681. **Mertin, J. V.** Oat Improvement in South Australia. *J. Ag. S.A.*, li (11), 1948, 532–537.—A general survey of the varietal and acreage position of oats in South Australia. There is an increasing demand for an oat capable of high production of green forage. The technique being used in testing varieties at Roseworthy College is described.

14682. **Morrow, J. A., Killeen, N. C., and Bath, J. G.** Development of Clover-ley Farming at Rutherglen Research Station. *J. Dept. Agr. Vic.*, xlvi (1), 1948, 13–20, 49–40.—Clover-ley farming is described as the rotation of cereal crops with or without fallow with sub-clover pastures. Experiments have been designed since 1922 to measure the improvement to soil fertility effected by this method. Fertilizer trials and cultivation practices in connection with clover-ley farming are described as well as rotational and manurial trials on regularly cropped land.

14683. **Morrow, J. A., Killeen, N. C., and Bath, J. G.** Rutherglen Research Station—Experimental Work and Results. *J. Agr. Vic.*, xlv (12), 1947, 537–545, 563.—Describes the scope of the experiments at Rutherglen. This report deals specifically with pasture investigations. Plots topdressed with superphosphate have carried 2·1 ewes per acre as compared with 1·3 ewes on unfertilized plots. The effect of topdressing was apparent for more than one year. The carrying capacity of clover pasture is only slightly greater than that of improved natural pasture. Topdressing and grazing trials are described.

14684. **Noonan, J. B.** Production of Field Beans in New England. *N.S.W. Ag. Gaz.*, lviii (11), 1947, 575–577; (12), 629–633.—Australian consumption is now 3,000 tons per annum, of which less than half is produced locally. In N.S.W. the New England district is best fitted for the production of the crop. Soil and climatic requirements of the crop, cultural methods, harvesting, marketing, varieties, diseases and pests.

14685. **Orman, A. C.** Growing Green Peas. *N.S.W. Ag. Gaz.*, xlix (2), 1948, 65–68.—Treated as an autumn, spring and summer crop according to climate. Cultural methods, harvesting and marketing are described. If there is a glut of green peas on the market, the crop may profitably be left for

14686. **Orman, A. C.** The Growing of Watermelons. *N.S.W. Ag. Gaz.*, lix (4), 1948, 190–192.—Soils and soil preparation, seeding and harvesting of watermelons and varieties are described.

14687. **Orman, A. C.** Prevention of Sprouting in Potatoes. *N.S.W. Ag. Gaz.*, lix (3), 1948, 128–129, 164.—Methylester of alpha naphthalene acetic acid and "Barsprout" were used in trials, and "Barsprout" gave excellent results. There are commercial possibilities for the treatment of main-crop potatoes.

14688. **Pugsley, A. T., and Hockley, S. R.** Flax Varieties and Flax Breeding. *S.A. J. Agr.*, li (2), 1947, 65–70.—Results of variety trials conducted at the Waite Institute for the seasons 1943–1946 show the general superiority of the Liral varieties to Concurrent and Giza Purple except in seed production. Wada, a rust-resistant variety bred in Western Australia, was promising in 1946. Crosses have been made to obtain rust resistance, rapid winter growth and dual purpose types.

14689. **Quinn, N. R.** Outdoor Tomato Culture. *S.A. J. Ag.*, li (2), 1947, 56–64.—Describing soil requirement of crops and methods of seed selection, seedling propagation, manuring and field treatment of the crop.

14690. **Quinn, N. R.** Glasshouse Tomato Culture. *J. Dept. Agr. S.A.*, li (4), 1947; li (5), 224–226.—Method of planting, training, pruning, watering, cultivation practices, ventilation and temperature control and varieties.

14691. **Raphael, T. D., and Walker, W. F.** French Beans. *Tas. J. Ag.*, xvii (3), 270–278.—Report on varietal tests over a three-year period and recommendations given.

14692. **Ross, A. R.** The Growing of Green Manure Crops in the Orchards of the Stanthorpe District. *Q. Ag. J.*, lxv (6), 1947, 389–395.—Leguminous crops should be grown whenever possible. A winter-growing species must be selected. Blue lupins has proved the most successful, with rye the best of the cereals. Time of planting and cultural methods are discussed.

14693. **Scott, R. C.** New Wheat Varieties and Disease Resistance. *S.A. J. Agr.*, li (11), 1948, 527.—The pedigree, characters and disease resistance of new varieties of wheat in South Australia.

14694. **Shirlow, N. S.** Richmond Wonder French Bean—A New Heavy-Yielding, Disease-Resistant Variety. *N.S.W. Ag. Gaz.*, lviii (9), 1947, 459.—Richmond Wonder (Clarendon Wonder × Wellington Wonder) possesses good resistance to halo blight and angular leafspot, crops well in hot weather and maintains an attractive appearance. Description of the variety.

14695. **Snook, L. G.** Locally Grown Leguminous Seeds. *J. Agric. W.A.*, xxiv (4), 1947, 300–312.—The chemical composition and food value of leguminous seeds, grown under local conditions, is given in detail.

14696. **Soutter, R. E.** Progress in Wheat Breeding, 1946–47. *Q. Ag. J.*, lxv (2), 1947, 101–114.—Locally bred varieties and strains, and introduced varieties were grown in row trials and disease reaction, yield and grain samples compared. A number of new hybrid selections show promise. Varieties and some crossbreds are described.

14697. **Thomas, I.** New Cereal Varieties in Western Australia. *J. Agr. W.A.*, xxiv (4), 1947, 341.—Particulars of the wheat variety Diadem and the oat Orient.

14698. **Thomas, P. H.** The Tasmanian Hop Industry. *J. Tas. Dept. Agr.*, xix (2), 1948, 79–87.—A description of the crop, with cultural methods and varieties.

14699. **Underwood, E. J., and Millington, A. J.** Further Studies with Cereal Hays in Western Australia. *J. Agr. W.A.*, xxiv (4), 1947, 249–258.—Reports on the experiments to measure curing losses and yields of hay cut at different stages. Loss of

dry matter was negligible. With the later cuts there was a very serious decline in digestible proteins. Recommendations for fodder conservation in the Western Australian wheat belt are given.

14700. **Whittet, J. W.** Temporary Pastures for the Wheat Rotation. *N.S.W. Ag. Gaz.*, lix (1), 1948, 10–11.—Recommended mixtures for different zones.

14701. **Williamson, J. A.** Hay Straddles. *N.S.W. Ag. Gaz.*, lix (4), 1948, 178–181—.Details with diagram are given for the construction of a straddle for a haystack.

3. SOILS AND FERTILIZERS.

14702. **Burvill, G. H.** Soil Salinity in the Agricultural Area of Western Australia. *J. Aust. Inst. Agric. Sci.*, xiii, 1947, 9–19.—Soil salinity has caused severe losses in Western Australian agriculture. Soil erosion occurs on areas bared by salinity. Reclamation involves (i) restriction of ground water movement; (ii) use of salt-tolerant plants to maintain a ground cover.

14703. **Fraser, H. A.** Wise Land Use on Wagga Soil Conservation Research Station. *J. Soil Conserv. Serv. N.S.W.*, iii, 1947, 108–112.—Land use redesigned, retiring land above 8% slope from cultivation; waterways and graded banks constructed.

14704. **Kaleski, L. G.** Conservation Farming in the Temora District. *J. Soil Conserv. Serv. N.S.W.*, iii, 1947, 96–100.—Sound rotations involving a minimum period under bare fallow, lay land and retention of stubbles successful.

14705. **Rossiter, R. C.** The Effect of Potassium on the Growth of Subterranean Clover and other Pasture Plants on Crawley Sand. 2. Field Plot Experiments. *J. Counc. Sci. Ind. Res. Aust.*, xx (3), 1947, 389–401.—Potassium fertilizer improved subterranean clover. Deficiency symptoms include bronzing of the upper portion of older leaflets, followed by reddish brown spots which lead to chlorosis and marginal necrosis. Healthy leaves contained 0·9% K, as compared with 0·4% to 0·6% in leaves showing deficiency symptoms.

14706. **Rossiter, R. C., and Kipps, E. H.** The Effect of Potassium on the Growth of Subterranean Clover and other Pasture Plants on Crawley Sand. 1. Pot-culture Experiments. *J. Counc. Sci. Ind. Res. Aust.*, xx (3), 1947, 379–388.—In presence of phosphate marked response to potassium in later growth of subterranean clover. Grasses did not respond to potassium. Gypsum depressed growth, possibly due to toxic effect of sulphate.

14707. **Sloan, W. J. S.** Some Aspects of the Problem of Soil Erosion Control in Queensland Cane Fields. *Qd. Agric. J.*, lxv (3), 1947, 165–171.—Widespread erosion occurs on the cane fields when clean cultivated. Avoidance of slopes over 10%, contour cultivation and soil cover suggested.

14708. **Stephens, C. G.** Pedogenesis Following the Dissection of Lateritic Regions in Southern Australia. *Counc. Sci. Ind. Res. Aust.*, 1947, Bul. No. 206.—Various degrees of truncation and dissection following laterite formation expose different layers of the laterite profile which become the parent material for the soils now observed. Examples of soil series formed on the different horizons are given. These occur in each of the States of southern Australia and Tasmania.

14709. **Stewart, J.** The Development of Inverell Soil Conservation Research Station. *J. Soil Conserv. Serv. N.S.W.*, iii, 1947, 113–118.—Severely gullied farm with much sheet erosion on arable areas. Land use redesigned and experiments laid down to study run-off.

14710. **Taylor, T. P.** Erosion Control in the Australian Capital Territory. *J. Soil Conserv. Surv. N.S.W.*, iii, 1947, 101–107.—Sheet erosion widespread, gullying common in grazing country. Reports success from pine plantations on damaged areas.

4. PLANT DISEASES.

14711. **Anon.** Diseases of Chrysanthemums. *Agric. Gaz. N.S.W.*, lviii (10), 1947, 535–540.—Brief descriptions of fungus, nematode and virus diseases and their control.

14712. **Anon.** Downy Mildew (Blue Mould) of Tobacco. *Ibid.*, lviii (11), 1947, 571–574.—Brief description of the disease, with recommended control measures.

14713. **Anon.** Diseases of Stocks. *Ibid.*, lix (1), 1948, 32–35.—Brief description of bacterial, fungus and virus diseases of stocks, and their control.

14714. **Anon.** Diseases of Daffodils. *Ibid.*, lix (11), 1948, 83–86.—Brief description of fungus, nematode and virus diseases and their control.

14715. **Angell, H. R.** The Influence of Fertilizers on Take-All of Wheat. *J. Coun. Sci. Ind. Res.*, xx (3), 1947, 372–378.—The percentage of plants with roots affected with *Ophiobolus graminis* was not significantly different in control plots and in variously fertilized plots, but the percentage with whiteheads or incipient whiteheads was significantly different. This difference appears to indicate that resistance to the development of the disease may be induced by fertilizer treatment. The percentage of whiteheads was significantly lower in plots manured with a mixture of ammonium sulphate and superphosphate, with or without trace elements.

14716. **Best, R. J.** Further Studies on the Physical States Assumed by Tobacco Mosaic Virus *in Vitro*. *Aust. J. Exp. Biol. and Med. Sci.*, xxv (3), 1947, 283–290.—Data are presented concerning the physical states assumed by pure preparations of tobacco mosaic virus at various concentrations of virus and NaCl. In the absence of salt, when the virus is less than 1%, an isotropic sol is obtained; when the virus concentration is between 1% and 2% a two-phase system of isotropic sol and birefringent crystalline liquid in equilibrium, and at higher virus concentrations only birefringent liquid phase is obtained. At low salt concentrations ($<0{\cdot}01$ M for univalent salts) the sequence is the same but the limiting concentrations of virus are higher. At intermediate salt concentrations, the upper limit varying with the nature of the salt roughly between 0·1 N and 1·0 N, the virus is precipitated slowly in the form of birefringent tactoids. They assume the form either of long flexible fibres or of aggregates of shorter fibres. At high salt concentrations (at and above the coagulating concentration for rapid precipitation of virus, i.e. from about 0·5 N and upwards) the virus is precipitated from solution in the form of birefringent microtactoids.

upon scientific and advanced technical books, then the unused balance may be applied to the importation of trades and crafts books and similar manuals. No unused part of the quarterly portion may be carried forward. Educational and research institutions would therefore be well advised to make arrangements to spread the purchase of American books through the year so as to relieve the October-December quota.

School in Marine Biochemistry

Thanks to the co-operation of the Division of Fisheries of the C.S.I.R. in providing accommodation and material, a School in Marine Biochemistry was held at the Marine Biological Laboratory, Cronulla, N.S.W., in the week commencing 7 August, 1948. The programme was designed to allow the investigation of problems which could not be satisfactorily undertaken by students away from the natural environment of the organisms. It included the following:

Intermediary Metabolism. The occurrence of cutochrome oxidase and succinic dehydrogenase determined in teleost, elasmobranch and molluscan tissue.

Phosphatases. An investigation of the enzymes in stingray muscle which hydrolyse pyrophosphate and glycerophosphate.

Ammoniogenesis. The course of ammonia formation in the blood and tissues from *Andara* and stingray.

Oxygen consumption in relation to Osmoregulation, using *Tapes* as the experimental animal.

The course was attended by students in the Third Year of Biochemistry at the University of Sydney. (See also *Nature*, 19 June, 1948.)

Smithson Research Fellowship

In accordance with the bequest of the late E. W. Smithson, a Fellowship has been established to promote "research in natural science, with a view to the discovery of new laws and principles rather than the exploitation of what is known". The Fellowship is open to all subjects of the British Commonwealth and Empire and is controlled by a Committee representing the Royal Society of London and the University of Cambridge. The appointment will be made for four years but may in exceptional circumstances be renewed by the Committee for further periods of one year each. Normally the Fellow will be required to carry out his research at the University of Cambridge as a member of that university. The stipend will be £900 a year and the Fellow will be required to contribute to a superannuation scheme.

"The Atom and Human Welfare"

A series of public lectures and discussions was arranged by the Royal Society of New South Wales and delivered in the month of July through the Extension Board of the University of Sydney, as follows:

D. P. Mellor, The atom and radioactivity.

R. E. B. Makinson, Artificial transformations and nuclear fission.

F. Lions, Atomic physics and human welfare (generation of power; radioactive tracers).

G. H. Briggs, International control of atomic energy.

Chemical Engineering

The Senate of the University of Sydney has accepted the following benefactions on behalf of its newly formed Department of Chemical Engineering—£600 from the Shell Oil Co. of Australia Ltd., £150 from the Neptune Oil Pty. Ltd., £250 from the Atlantic Union Oil Co. Ltd., and £125 for prizes from W. G. Wright.

A foundation Chair of Chemical Engineering has been established in the New South Wales Institute of Technology, with a salary of £1,500 per annum.

University of Sydney

Mr. W. M. Robb, M.A., has been appointed Registrar of the New England University College. The Mechanical Engineering Department has received a gift of a variable compression engine from the Commonwealth Oil Refineries and two centrifugal pumps from Mather and Platt Ltd. The Department of Geology has received a benefaction of £350 from the North Broken Hill Pty. Ltd. The Commonwealth Bank of Australia has given £200 towards the completion of the research laboratories of the Department of Veterinary Physiology.

Tucker-Price Research Fellowship

The Tucker-Price Fellowship is awarded at Girton College, Cambridge, for research in mathematics, natural sciences, engineering, medicine, experimental psychology, physical geography or agriculture. Women who are graduates or have taken honours in the final degree examination are eligible, with preference to those between twenty-five and thirty-five years of age. Tenure is for three years, at £250 a year in addition to residence. Applications should reach the Secretary of the College by 15 January, 1949.

Australian National University

The first professorial appointment to the Australian National University is that of Dr. A. H. Ennor, to the Chair of Biochemistry. Professor Ennor is thirty-five years of age. After graduating at the University of Melbourne with distinction in chemistry, physiology and biochemistry, he was for several years biochemist at the Baker Institute for Medical Research. He carried out work under grants from the National Health and Medical Research Council and in 1942 joined the Chemical Warfare Section of the Ministry of Munitions. In 1944 he obtained the degree of Doctor of Science and in 1945 visited chemical warfare centres overseas on behalf of the

Australian Government. In 1946 and 1947 he was engaged in research in the Department of Biochemistry in the University of Oxford, as a research fellow of the Wellcome Foundation. At the time of his appointment to the National University, Professor Ennor was senior biochemist of the Commonwealth Serum Laboratories, Melbourne. Arrangements have been made with the Serum Laboratories for the work of his Department to be housed there until university accommodation is available.

Obituary

Mrs. Ada a'Beckett, C.B.E., whose death is announced, was formerly lecturer in Biology in the University of Melbourne. She was the first woman to be appointed to the staff of that university.

The death is announced of H. B. Kirk, Professor of Biology in the Victoria University College, New Zealand.

Royal Society of London

Sir Stafford Cripps has been elected a Fellow of the Royal Society under the provision of Statute 12.

The following have been elected foreign members: D. W. Bronk, Director of the Eldridge Reeves Foundation for Medical Physics in the University of Pennsylvania; L. E. J. Brouwer, Professor of Mathematics in the University of Amsterdam; Maurice Caullery, formerly Professor of Biology at the Sorbonne; L. C. Pauling, Professor of Chemistry at the California Institute of Technology.

United States Awards

The United States *Medal for Merit*, which is the highest award made to a civilian by the President, has been given to Sir Alexander Fleming and Sir Howard Florey for their war service in connexion with penicillin. The following awards have been made by the United States Academy of Sciences: *Henry Draper Medal*, to H. A. Bethe, of Cornell, for his contributions to astronomical physics in relation to the generation of stellar energy; *Agassiz Medal*, to F. A. V. Meinesz, of Utrecht, for his contributions to oceanography; *Walcott Medal*, to A. G. Vologdin, of Moscow, for his studies of Pre-Cambrian and Cambrian algae, especially the Archaeocyatha.

The third annual award of the Sugar Research Foundation, of value 5000 dollars, has been made to Dr. Leslie F. Wiggins, of the Chemistry Department of the University of Birmingham. The work of Dr. Wiggins has been chiefly in finding an efficient conversion method for lævulinic acid. From this he has derived products such as sulpha drugs, analgesics and nylon ingredients. The sodium or calcium salt of the acid makes a good antifreeze, cheaper than glycol or glycerine. Other products include drugs for reducing blood pressure, solvents, emulsifying and wetting agents, a synthetic coconut flavour, and a wholly chemical method for producing lactic acid. Dr. Wiggins has been appointed Research Director of the recently created Imperial College of Tropical Agriculture, Kingston, Jamaica.

The Night Sky in November and December

The summer solstice of the Earth occurs at December 22d. 09h. New moon occurs at November 1d 16h. 02m., December 1d. 04h. 44m. and December 30d. 19h. 44m., Eastern Australian Time; Full Moon occurs at November 17d. 04h. 31m., and December 16d. 19h. 11m., Eastern Australian Time. The Moon is successively in conjunction with Mars, November 4d. 03h.; Jupiter, November 5d. 06h.; Saturn, November 24d. 12h.; Venus, November 28d. 16h.; Jupiter, December 3d. 02h.; Mars, December 3d. 03h.; Saturn, December 21d. 19h.; Venus, December 28d. 16h. Mars and Jupiter are in conjunction at December 1d. 18h. Mercury is a morning star in November but is close to the sun in December. Venus is a morning star, two hours ahead of the sun; Mars an evening star nearly two hours behind the sun, while Jupiter moves forward past it. Saturn rises about two hours before midnight early in November and about two hours after midnight late in December.

Social Sciences

A Section for Social Sciences has been created in the Division of Higher Education of the United States Office of Education. It is to serve as a clearing house for information concerning teaching and research techniques. The staff is to include Dr. Claude E. Hawley as Associate Chief for Social Sciences and as specialist for Political Science, Dr. Otis W. Freeman as specialist for Geography, Dr. J. Laurence Phalan as specialist for Economics and Dr. Jennings B. Sanders as specialist for History. The address is: Federal Security Agency, Office of Education, Washington 25, D.C.

The Olympic Torch

The investigation for the design of the torch, to be carried in turn for fifteen minutes by each of 1600 runners to the recent Olympic Games, was undertaken by Dr. L. R. B. Shackleton, of the Fuel Research Organization, D.S.I.R., England. The torch had to be light, easy and sure to ignite, without high fire risk in storing, and with a visible but not very smoky flame. It was decided to use hexamine in tablet form, with the addition of 6 per cent of naphthalene to make the flame visible in all weathers. After trial of prototype torches and subsequent modifications, the external design was produced by an architect, R. Lavers, in die-cast aluminium alloy. Seven tablets of fuel were enclosed in a perforated metal cylinder with an inner sleeve concealing the lower three tablets. As the upper tablets burned away, the lower reserves were forced up into the burning zone by a spring. A tablet of nitrate composition was placed on top of

the fuel pack to facilitate lighting, with a quick-match protruding through the perforated container to enable ignition. To preserve the fuel and avoid accidental ignition, the tablets were enclosed in a nitrocellulose cover and the container was seal-capped with adhesive tape.

Visual Aids in Learning Science

A set of three strip films, 35 mm. wide, has been prepared by The Macmillan Company for use with the third edition of J. W. Mavor's *General Biology* and *Laboratory Exercises in General Biology* which have just been published. The films illustrate only three selected sections of the text. Two of them are botanical—on the alternation of generation of plants and on plant physiology—and consist largely of drawings and diagrams which to some extent include figures that appear also in the text. The third film is on life through the ages and comprises material not included in the text.

In conjunction with the revised edition of Part I (Physical Geology) of the *Textbook of Geology* by Longwell, Knopf and Flint, just published by John Wiley and Sons, a set of 250 Kodachrome slides has been prepared and issued. Most of the photographs were taken for the purpose by Assistant Professor O. E. Childs of the Colgate University. They include only a few diagrams, as it is intended that the text should be the medium for presenting diagrams while the coloured slides can give a more realistic impression of geological field forms and agent-actions and of rocks and minerals.

A monthly television programme drawn from museum material is presented by the Museum of Natural History, Cleveland, U.S.A. The Museum also includes a brief weekly television programme in connexion with its juvenile "Explorers' Clubs". For the latter purpose it has covered subjects such as Indian life, fur-bearing mammals, care of pets, bird migration and signs of spring.

The International Unions

UNESCO Grants-in-Aid

The chief purposes for which the various grants-in-aid to the International Scientific Unions for 1948 will be allocated are as follows.

International Council of Scientific Unions, $30,934. Expenses of travelling, secretarial work and publication for the Executive, for Joint Commissions and for ICSU-UNESCO liaison.

International Astronomical Union, $21,880. Support for the International Latitude Bureau and International Time Bureau; part travelling expenses for the General Assembly; publications.

I.U. of Biological Sciences, $22,945. Travelling expenses to the Congresses of Genetics, Zoology and Entomology; publication of Congress reports; subsidies to Sections of Botany, Cell Biology, Embryology, Entomology, Genetics, Microbiology and Zoology; various grants, e.g., to Marine Biological Stations, International Microscopic Collection and abstracting; four travel grants to non-European scientists.

I.U. Chemistry, $11,325. Travelling expenses and publications in connection with the Commissions of Tables of Constants, of New Analytic Reagents, of Study of Fats, of Macromolecular Chemistry, of Encyclopaedias and Documentation.

I.U. Crystallography, $8,000. Publication of *Acta Crystallographica* and *Structure Reports.*

I.U. Geodesy and Geophysics, $34,270. Contributions to the permanent international services, including the Int. Seismological Summary, Int. Time Bureau, Int. Bureau of Isostatic Reductions and Int. Latitude Service; to the Int. Comparison of geomagnetic standard instruments; major publications of the constituent Associations of the Union; travelling expenses for the General Assembly.

I.U. Geography, $2,000. Travelling expenses for the Lisbon Congress.

I.U. History of Science, $8,900. Travelling expenses for the Executive and Commissions; publications.

I.U. Theoretical and Applied Mechanics, $7,200. Travelling expenses and publication for the General Assembly.

I.U. Pure and Applied Physics, $15,300. Travelling expenses for the Executive and the Commissions of Symbols, of Units and Nomenclature, of Radioactivity, of Optics; Symposium on the Physics of Metals; travel grants for physicists working in a country other than their own; reports of Commissions and of Symposia on Cosmic Rays and on Physics of Metals; publications of the International Centre of Documentation for Optics.

I.U. Scientific Radio, $9,000. Travelling expenses and publication for the General Assembly; publication of the *Monthly Bulletin* and *Special Reports.*

Additional grants from UNESCO for International Congresses include: Zoology, $3,000; Genetics, $4,000; Entomology, $3,000. Grants for Special Agencies include: International High Altitude Research Station, Jungfraujoch, $4,000; International Zoological Station, Naples, $10,000; International Commission on Zoological Nomenclature, $10,600; International Association of Microbioloigsts for Centres of Type Culture Collections, $25,900.

It will not be posible to pay all of these grants in dollar funds. In selecting invited participants who will receive transportation expenses to meetings, preference will be given to scientists from war-devastated countries and also to young scientists.

An analysis of the grants-in-aid shows that they are allocated to various purposes as follows:

Transportation expenses for meetings of symposia, commissions, etc.	$38,644

Transportation expenses for meetings of general congresses and assemblies	$44,040
Travel grants	$11,000
Publications	$49,530
Permanent international services ..	$39,500
International laboratories and stockrooms	$39,400
Overhead for administration of grants	$11,060
	$233,174

The approximate distribution among the sciences is:

General sciences, including history of science	16·3%
Physical, celestial, earth and chemical sciences	46·4%
Biological sciences	37·3%

The UNESCO grants-in-aid will help the realization of about 120 different projects, the meetings of about 450 scientists at about 50 international conferences, the publication of about 40 reports, bulletins or journals and the work of about 30 international services, laboratories and stockrooms.

Personal

Mr. R. M. Gascoigne, M.Sc., A.A.C.I., has been awarded an Imperial Chemical Industries Fellowship and has gone to work for three years with Professor A. Robertson in the Department of Organic Chemistry at the University of Liverpool.

The H. G. Smith Memorial Medal for 1948 has been awarded by the Australian Chemical Institute to Dr. M. R. Lemberg, Ph.D., A.A.C.I., biochemist of the Royal North Shore Hospital, Sydney, in recognition of his contribution to the chemistry and biochemistry of the respiratory and bile pigments and related enzymes. The Medal, which commemorates H. G. Smith (1852-1924), of the Technological Museum, Sydney, is awarded annually for an outstanding contribution to the development of chemical science in Australia.

Arrangements have been made for Dr. Frank Dixey, geological adviser to the Secretary of State for Colonies and Director of Geological Surveys, to visit Fiji to discuss plans for a geological survey of the territories of the Western Pacific High Commission. The Bureau of Mineral Resources, Australia, in conjunction with Zinc Corporation Ltd., is studying the application of geochemical techniques in selected areas, with the guidance of Dr. V. P. Sokoloff, of the United States Geological Survey, who is spending six months in Australia for the purpose.

The Scientific Societies

Royal Society of Tasmania.

August: T. D. Raphael—Bees, the production of pedigree stock.

September: Geological research in Tasmania.

Royal Society of New South Wales.

Liversidge Research Lecture: Ian Lauder—Some recent work on the separation and use of stable isotopes.

September: I. A. Brown—Occurrence of the Brachiopod Genus *Plectodonta* Kozlowski at Bowning, N.S.W.

G. D. Osborne and P. B. Andrews—Structural data for the northern end of the Stroud-Gloucester Trough.

R. C. L. Bosworth—The concepts of Resistance, Capacitance and Inductance in thermal circuits.

Royal Society of Victoria.

August: N. H. Rosenthal (lecture)—Visual aid in education.

September: P. G. Law (lecture)—The Australian National Antarctic Research Expedition, 1947-1948.

Royal Society of South Australia.

August: Discussion on the Scientific Investigation of problems affecting the development of Northern Australia.

Medical Sciences Club of South Australia.

August: S. McLean—Staphylococcal bacteriophages and their use in typeing strains of staphylococci in epidemics.

P. Nossal—A new catalytic function of oxyhæmoglobin.

D. J. B. Kerr—The dynamics of hæmoglobin catalysis.

N. D. Crosby—A physiological approach to the problem of Enuresis.

September: M. F. Pulsford—Microphthalmia in pigs.

J. A. Lewis—The insulin treatment of schizophrenia and some theories as to its mode of action.

D. A. LeMessurier—Sensory reception areas in the rat cortex.

Royal Society of Western Australia.

June: C. A. Gardner and E. M. Watson—*Eucalyptus oleosa*; the varieties and their oil yields in South-Western Australia.

R. E. Stewart—Investigations on the leaf spot of black mulberries caused by *Septogloeum mori*.

S. E. Terrill—Notes on the use of the term "laterite" and on laterites in the Darling Range near Perth.

British Astronomical Association, N.S.W. Branch.

Officers, 1948-1949: President, W. H. Robertson; Hon. Secretary-Treasurer, J. H. Catts; Editor, W. H. Robertson; Assistant Editor, E. M. Mitchell.

August: H. W. Wood—Some statistics about comets.

W. G. Hanson—Astronomy and Ancient Egypt.

September: J. H. Catts—Ice ages.

October: J. B. Sidgwick—Aperture, focal length and focal ratio.

Linnean Society of New South Wales.

September: T. B. Kiely—Preliminary studies on the Ascigerous stage of *Phoma citricarpa* McAlp. and its relation to Black Spot of Citrus.

V. May—Studies on Australian Marine Algae iv. Further geographical notes.

G. H. Hardy—Miscellaneous notes on Australian Diptera. xiv. Venation and other notes.

H. Oldroyd—Diptera of the Territory of New Guinea. xiv. Family Tabanidae. Part III. Tabaninae.

October: S. J. Copland—Taxonomic notes on the genus *Ablepharus* (Sauria. Scincidae), ii. The races of *Ablepharus burnetti* Oudemans.

I. M. and J. M. Mackerras—Revisional notes on Australasian Simuliidae (Diptera).

R. H. Wharton—New species of Simuliidae from New South Wales.

A. R. Woodhill—Observations on the comparative survival of various stages of *Aëdes* (*Stegomyia*) *scutellaris* Walker and *Aëdes* (*Stegomyia*) *aegypti* Linnaeus at varying temperatures and humidities.

J. Crockford—Bryozoa from the Upper Carboniferous of Queensland and New South Wales.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

Influenza-A Strain from 1948 Outbreak in Melbourne

The type of influenza-A virus which was responsible for the 1947 epidemic of influenza in the United States and against which the current influenza vaccine failed to protect has been shown by Rasmussen, Stokes and Smadel to be more closely related to the Australian strain CAM, isolated in the previous year, than to any previous strains. In view of the possibility that further changes in the antigenic type of influenza virus may be detected in Australia before they appear in the Northern Hemisphere, it is desirable to record the occurrence of a strain of influenza-A virus which shows some antigenic difference from those isolated in earlier years.

The strain FJS was isolated in May, 1948, by the usual technique of amniotic inoculation from a pool of throat washings in a small school epidemic in Melbourne. Four of the seven patients tested showed a significant antibody rise to the new strain. The accompanying table shows in outline the serological relationship of the new strain to the 1946 Australian strain CAM and the 1947 American FMI. The titres are those of anti-hæmagglutinin titrations of representative human sera made by the standard method used in this laboratory from the epidemics concerned.

Serum	Virus.		
	FJS (1948)	FMI (1947)	CAM (1946)
1946 Australia—			
To	20–20	30–30	<10–320
He	<10–<10	10–40	<10–100
Cl	<10–30	<10–240	<10–360
1947 America—			
Ca	15–60	40–240	<10–40
Bn	15–60	80–320	80–320
1948 Australia—			
An	<10–80	30–240	15–320
Ku	20–80	60–160	15–240

It will be seen that the new strain is nearer FMI than CAM. A point of interest, the significance of which will be discussed elsewhere, is that 1948 sera neutralize the 1946 strain readily but the 1946 sera have no significant effect against the 1948 strain.

Dried virus of strain FJS has been sent to several overseas laboratories.

S. G. Anderson.

The Walter and Eliza Hall
Institute of Medical Research,
Melbourne.

25 August, 1948.

Reference

Rasmussen, A. F., Jnr., Stokes, Julia C. and Smadel, J. C. (1948): *Amer. Jour. Hygiene*, 47, 142.

A Differential Comparator Operating at Radio-Frequency

This apparatus provides a rapid and accurate conductrimetric method of comparing the concentration of solutions and for mixing fresh supplies of a reagent without the employment of a chemical balance.

The comparator consists of two conductimetric tubes G and G′ (Figure I). Each is complete with a screening cylinder, a rectifier (either a fixed crystal or a "Westector" is suitable), and a radio-frquency choke (Blake, 1947, a and b); these are enclosed within an earthed metal screening case and are shown by dotted lines in Figure I. It is convenient to place the micro-ammeter M and the control knob of the potentiometer in front of the case. A micro-burette B can be attached to the side of the latter, provision being made to enable it to be raised or lowered as desired above the solution.

By depressing and releasing a rubber bulb X at the head of the burette, the latter is filled with a saturated solution of the required reagent. Small measured quantities are ejected by gradually tightening the thumb screw S. The lead O which makes connexion to a radio-frequency oscillator (the latter is not shown in the figure) should be screened. Instead of balancing the output from a single rectifier as in Blake, 1947b, a similar result is achieved by the employment of two rectifiers Re and Re′ which are connected in opposition thus enabling the voltage applied to the micro-ammeter to be adjusted to zero by means of the potentiometer P. H and H′ are radio-frequency chokes, and C and C′ are condensers.

Above each of the conductimetric tubes are reservoirs V and V′. A syringe (not shown in Figure I) is connected to U by a length of rubber tube. An air inlet valve or a tap is provided which can be operated when desired in order to bubble air through the solution to stir it.

The method of operation when mixing a solution is as follows:

A sample of the standard solution which it is desired to match is drawn up into each of the conductimetric tubes. When only a very small quantity is available small containers as shown at D in the figure holding only two or three cubic centimetres can be employed.

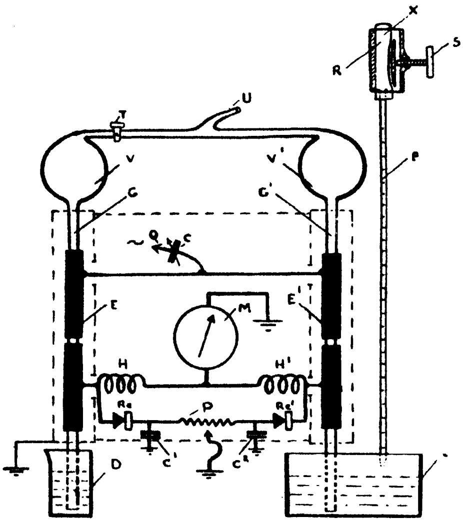

Figure I.

A radio-frequency current is applied simultaneously to the two acceptor electrodes E and E′. This is regulated by a coupling condenser C which should be incorporated in the 1175 kc. oscillator.

The needle of the micro-ammeter is then balanced to zero by adjustment of the potentiometer P. After this the container under the right hand conductimetric tube is removed and replaced by a large container (of any cubic capacity desired) containing the new solution the concentration of which need only be a rough approximation to that required. Comparison is made with the standard solution in the left hand tube and either more reagent or more distilled water is added until the meter again balances at central zero. During preliminary stages the reagent or water is added by means of a pipette and the final critical agreement between the two solution concentrations is achieved by use of the microburette.

Titrations can also be carried out with this apparatus. (1) Using only one conductimetric tube. In this case the left hand tube should be empty and is kept out of action by closing tap T. (2) Alternatively, both of the conductimetric tubes may be filled with the solution under analysis and the reagent added only to that in container D′. The Potentiometer is used to set the needle of the micro-ammeter at any desired position on its scale before commencing in similar manner to that described by the writer (1947b) for the zero-shunt.

G. G. BLAKE.

Department of Physics,
University of Sydney.
12 July, 1948.

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Photolysis of Cellulose in the Presence of Tungstic Acid

Recently it has been shown that tungstic acid finely dispersed on dry cellulose (paper, cotton, artificial silk, etc.) turns blue when exposed to light. This photochemical reaction is reversible and the preparation loses its colour when protected from light (A. Bollinger, 1946). Subsequently the cellulose which seemed to be necessary for the reaction was examined. For this purpose circles of filter paper of high purity (Whatman, No. 40, 11 cm. diameter) were impregnated with a colloidal tungstic acid solution, protected from light, and dried in a desiccator or in air at room temperature as described before. Then for a week or more they were exposed to sunlight (winter sun) behind a plate-glass window. Immediately on exposure to the sun's rays the papers began to turn blue and reached the maximum colour, a deep sky-blue, in less than thirty minutes. Overnight these papers lost their colour which was restored again as soon as exposed to the morning sun.

As a first approach to the problem, these papers, after exposure to sunlight, were examined for water-soluble reducing substances at daily intervals. They were folded up and transferred to a test tube and then extracted with cold water (about 5 ml.) for five minutes. The aqueous extract was then filtered through a water washed filter. This procedure was repeated once, and then three times with hot water. The combined filtrates were neutralized with 0·1 N sodium hydroxide using phenolphthalein as indicator. By this method the filter papers were found to contain 0·4 to 0·8 ml. 0·1 N acidity. The neutralized filtrate was concentrated to 10 ml. and 5 ml. of the concentrate was used for the determination of reducing substances by the method of Somogyi (1926). The results were expressed in terms of glucose.

One day of exposure to sunlight brought on a reduction of the extract amounting to about 0·05-0·1 mgm. of glucose. This increased in subsequent days and reached an approximate maximum of 3 mgm. after 7-10 days. With dinitrophenylhydrazine a precipitate was readily obtained from these reducing water-extracts. With phenylhydrazine a precipitate formed, which on microscopic examination seemed to consist mainly of osazones of cellobiose and some related di- or tri-saccharides. This was supported by the hydrolysis of the

aqueous extract with 4N hydrochloric acid, which now yielded a glucosazone on treatment with phenylhydrazine. Simultaneously the value for reducing substances, expressed as glucose, increased to about twice the value obtained before hydrolysis of the water extract, i.e., 6 mgm. or 0·6 per cent. of the cellulose exposed to the sun.

Filter papers impregnated with the stable aqueous solutions of the heteropolyacids of tungsten, such as phospho-, silico-, and boro-tungstic acid turned grey or grey-blue when exposed to light. When protected from light they lost their grey colour. However, the colour change of the filter papers impregnated with heteropolyacids was definitely slower than with tungstic acid preparations and it took approximately twenty minutes for a noticeable colour to develop. Nevertheless, degradation took place as with tungstic acid and after five days of exposure to sunlight the water extract of the filter paper was found to contain 0·2 per cent. of reducing substances, which increased to 0·4 per cent. after acid hydrolysis.

More marked effects could be obtained by exposing the impregnated filter papers to the rays of a mercury vapour lamp. After intermittent exposure totalling twelve hours, 0·5 per cent. of the cellulose impregnated with silico-tungstic acid was found to be water-soluble and reducing. About 1 per cent. of the cellulose was found to be present in the form of glucose in the hydrolysed water extract.

It has been known for a considerable time that sun, and particularly ultra-violet light, have a detrimental effect on cellulose fibres and tissues. Recently Heuser (1944) has summarized the literature on the subject. Present experiments, however, indicate that the addition of small amounts of tungstic acid may intensify this degradation about tenfold. As pointed out before, filter papers impregnated with a solution of sodium tungstate (about 1 per cent.) and sulphuric acid (0·06N) and then dried, were found to contain 0·6 per cent. glucose after ten days exposure to sunlight. Controls treated with sulphuric acid only yielded 0·06 per cent. glucose.

These experiments indicate that air-dried cellulose, when exposed to sunlight or the rays of a mercury vapour lamp, saccharifies to an unexpectedly high degree in the presence of small amounts of tungstic acid.

Besides theoretical considerations in connexion with the mechanism of this reaction, the question will be examined whether a similar process of cellulose degradation plays a role in nature or has any practical application.

A. Bolliger,
N. T. Hinks.

Gordon Craig Research Laboratory,
Department of Surgery,
University of Sydney.
8 September, 1948.

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Views

A Reply to Dr. Burnet

I feel compelled to reply to Dr. Burnet's article in the last issue of this Journal as it appears basically opposed to a well tested conviction of my own. I am convinced that teaching and research react each to improve the other. In particular I believe that the best type of education, the kind that develops the originality and flexibility of thought which are first essentials in the present rapidly changing world, comes from a teacher who is actively practising the development of new patterns in thought; in other words, from one who is an active research worker. Dr. Burnet's suggested professor with his emphasis on organization and interest in mechanical studies such as visual aids and aptitude tests, gives me a depressing picture very characteristic of efficient mass production but lacking the most vital feature in education, the development of the individual original ability that should have some place in the mental make-up of all students.

What I have so far written sounds vague and unpractical. I shall endeavour to make it concrete by speaking of my own laboratory. I claim that in this laboratory the application of the closest relationship between teaching and research has been demonstrably successful. In the field of research the laboratory has published since the war nineteen papers, all of substantial research content. Most of these have appeared in well known British and American journals, and six more have been accepted for publication. I feel that these facts give an answer to Dr. Burnet's rather contemptuous reference to part-time research.

The two senior members of our staff, Dr. Cruickshank and myself, have been actively concerned in the work recorded in these publications. We have also both made experiments in teaching methods which I would claim have been successful. In Dr. Cruickshank's case an account of some of his developments in the teaching of experimental work in first and second year physics courses will appear shortly in the *American Journal of Physics*. Of more importance in view of the present controversy is that Dr. Cruickshank will be prepared to give an account of this work at the coming Hobart meeting of A.N.Z.A.A.S. I hope that Dr. Burnet and others interested in the matter will manage to find time to attend this session as his method is essentially one which emphasizes the research approach to teaching.

In my own case, I have experimented in adult education: an account appeared in this

JOURNAL, Vol. X, No. 2. If this account is read it will be seen that the teaching is entirely based on a research approach. For the last three years I have experimented in primary teaching and I continually experiment in university lectures. Such success as I have achieved springs entirely from my continued fresh contact with bench research.

In this laboratory during the war we successfully solved certain optical problems in which others in more favourable conditions had been unsuccessful. This success was the direct result of immediate contact with the problem by the heads of the department. Teaching was at once necessary at all levels, from research methods to principles of elementary optics and special hand techniques. A production annexe using new methods was quickly built up as a result of a close research-teaching liaison. It made useful contributions to Australia's part in the war.

Dr. Burnet's article appears to be inspired by his belief that all is not well with Australian science teaching. It seems relevant for me to state what I think is wrong with Australian science. In my opinion too many people sit for too long on boards, instead of working at science. The longer they sit on boards the less they remember what this science is all about. On the other hand, the more they sit on boards the more wealth and power they accumulate and the more they sit on boards. (I seem to see Dr. Burnet's professor sitting on a great many boards.) More and more money is spent on organizing less and less science. Organizing science in Australia suggests to me heaping bed clothes on an infant till it suffocates and no longer needs the food it doesn't get anyway.

To sum up, I am convinced that the best teaching in science comes from people who are actively engaged in research. These provide best that essential factor in education, the development of the individual originality of a student. On the other hand, research benefits by the research man teaching outside his specialty, because he is prevented from keeping his mind in too narrow a track, and because outside analogies and applications widen his approach to his specialty. I present the record of my own laboratory in support of these contentions.

I do agree, however, that Dr. Burnet's suggested method would be more successful than mine would in producing masses of machine made medicos.

A. L. MCAULAY.

University of Tasmania,
20 September, 1948.

"Science at the Cross Roads"

The points raised by Mr. Withers in his recent letter[1] with reference to my previous contributions[2] were not new and were dealt with in my reply of October, 1947. Anyone interested in the interpretation of the two original articles[3] may readily judge, by reading them, who is responsible for misinterpretation.

ILSE ROSENTHAL-SCHNEIDER.

University of Sydney,
20 September, 1948.

[1] This JOURNAL, *11*, 29.
[2] Ibid., *9*, 161; *10*, 54.
[3] *Nature*, *125*, 225; *126*, 497.

Reviews

Agriculture

TECHNIQUE OF BREEDING FOR DROUGHT RESISTANCE IN CROPS. By T. Ashton. (Technical Communication No. 14, Commonwealth Bureau of Plant Breeding and Genetics, Cambridge, 1948. 34 pp.) Obtainable from the C.A.B. Liaison Officer, 314 Albert Street, East Melbourne, C.2, Victoria. Price: 3s. 2d.

The publication reviews the more important literature relating to the complex problems of breeding for drought resistance in the principal farm crops and in some grasses. There is a bibliography of 124 references.

Much of the account is devoted to wheat, in regard to which Russian sources are well covered. Mention is made of the *Triticum-Agropyron* hybrids. Wild oats, maize, sweet-corn, barley, rice and millet, together with mixed crops (some tropical and sub-tropical) are only very briefly covered. It is unfortunate that grass species are considered as crops, when it is becoming increasingly recognized that drought-resistance in grasses must be considered in relation to pasture problems, especially grazing practice.

The communication brings out the fact that extraordinarily little specific breeding for drought resistance has been undertaken. This may be mainly due to the complex nature of physiological reactions to drought and the consequent difficulty of securing reliable criteria or standards with which to work. Simple direct measures, whether of a morphological character or based on osmotic pressure or transpiration, have been found quite unreliable. The more recent attempts at providing indirect indices have emphasized the use of physico-chemical characters of various kinds. Although some of these show promise for specific plants, there is no agreement as to their general value. On the other hand, there have been some useful experiments in which pot cultures in special drought chambers have been employed. Increasing emphasis has been placed on to variation of reaction to drought according to the stage of the plant's development.

H. C. TRUMBLE.

Bacteriology

DAIRY BACTERIOLOGY. By B. W. Hammer. (New York: John Wiley and Sons Inc.; London: Chapman and Hall Ltd. Third Edition, 1948. 593 pp., 49 text-figures, 9″ × 6″.) Price, $6.00.

Dr. Hammer has done a very valuable service in bringing up to date what has become recognized as the standard textbook in the subject of dairy microbiology. In its general plan this edition is very similar to the previous two, although there are some changes in the order of treatment and a final chapter has been added dealing with the bacteriology of dairy-plant water supplies. The detailed statement of chapter contents has been replaced by simple chapter headings and the method of quoting references seems, to the reviewer, to leave much to be desired. Although the references are now gathered together at the end of each chapter, their presentation seems to serve the purpose of brevity rather than of assisting a reader who might happen to want a quick check on a particular work.

It is not surprising that such a book as this, developed in the first place for American teaching institutions and laboratories, should have much of its discussion over-weighted by that country's findings and practices. More particularly one feels that this is so in chapters dealing with tests of raw milks: those concerned with milk products appear to have achieved a better balance between American and British work. The Australian reader will need to take account of this feature, particularly where local regulations follow British more closely than American practice.

The book is well printed on good paper and very well bound—properties that one has come to expect in American books.

J. M. VINCENT.

Chemistry

QUANTITATIVE ANALYSIS. By W. C. Pierce and E. L. Haenisch. Third Edition. (New York: John Wiley and Sons Inc.; London: Chapman and Hall Ltd., 1948. 520 pp., numerous tables. 6″ × 9″.) Price, $3.75.

This textbook, designed primarily for a First Year course in quantitative analysis, was first published in 1937, with a second edition in 1940. The present edition retains the format of its predecessors, the only notable change being the transference of the section dealing with complex equilibria from the appendix to the main text. The content has been expanded by the amplification of the section dealing with the theory of precipitation, and the inclusion of additional questions and problems at the end of each chapter. The answers to the problems are not included, but may be obtained (by teachers) from the publishers. The book is divided into four parts and an appendix: Part I, Fundamentals; Part II, Volumetric Analysis; Part III, Gravimetric Analysis; Part IV, Special Methods.

Part I deals with the fundamental operations of weighing, calibration of weights, order of accuracy, sampling, and the preparation of the sample for analysis.

Part II occupies almost half of the book. Such emphasis on volumetric analysis is in conformity with the authors' belief that volumetric methods have the greater teaching value, as well as being more in concordance with modern analytical trends. The discussion on apparatus, methods and calculations is followed by an extensive treatment of the theory of neutralization, oxidation reduction reactions and indicators. An excellent feature of this section is the use of milli-equivalents, and milli-moles as applied to stoichiometric calculations, but the theoretical discussion seems far too advanced for elementary students. Many modern textbooks of quantitative analysis give the impression that their authors have been in a bitter dilemma as to the amount of physical chemistry that should be included. Some authors have solved the difficulty by merely rewriting chemistry books with incidental pieces of analytical procedures as a thin cement. The result is pretentious, and misleading to the student. Analysis, even with the aid of the more exact knowledge of the mechanisms of reactions, is still much more of an art than a science. The authors of this book appear to have been unable to strike some happy medium and the theoretical discussions are thus a curious mixture of the elementary and very advanced. For example (pp. 277-279), the feasibility of the use of permanganate for the titration of ferrous and chloride ion is decided from calculations of the equilibrium constants of the reactions, whilst later (p. 341) an unconvincing discussion of the insolubility of silver chloride concludes with the statement that the facts of solubility are quite unexplainable and must be accepted as empirical.

The technique of gravimetric analysis, the methods and apparatus are described in Part III. In the theoretical section it is regrettable that the authors have perpetuated the old derivation of the Solubility Product Constant by assuming that the concentration of the solid phase is constant. On page 354 the dubious statement is made that the solubility of lead sulphate in very dilute nitric acid is probably due to the formation of both complex lead ions and of bisulphate ions. The exercises are iron by ferric hydroxide, sulphur (in three forms) by barium sulphate, and phosphate by magnesium pyrophosphate. A much wider and better selection would be desirable. As the sole example of the use of organic precipitants, magnesium is estimated again—with 8 hydroxyquinoline. Dimethylglyoxime receives but a scant mention as useful for nickel and certain other metals. The section concludes with the estimation of silica, magnesium and carbonate in rocks and minerals.

The small Part IV on special methods gives details for the electroanalysis of copper and

nickel, and includes a discussion on electrometric titrations. The inclusion of five figure logarithms in the appendix appears to be unrealistic for beginners in quantitative analysis.

The book is very well set up and indexed, and only a few minor typographical errors have been noted.

F. P. DWYER.

Engineering

ELECTRIC MOTOR MAINTENANCE. By W. W. McCullough. (New York: John Wiley and Sons; London: Chapman and Hall Ltd., 1947. 126 pp., many photographs.) Price, $2.00.

A book of interest to those concerned with the repair, maintenance, and operation of electric motors. It deals with such subjects as bearings and lubrication, commutator and brush maintenance, insulating materials and varnishes, drying-out of motors and the like. The author has wisely omitted reference to the comprehensive subject of windings and connexions, which is sometimes given in similar books in such compressed form as to be virtually valueless, but he has filled his pages with much practical lore which would be invaluable in the workshop.

A. G. DOE.

MAGNETIC CONTROL OF INDUSTRIAL MOTORS. By G. W. Heumann. (New York: John Wiley and Sons Inc.; London: Chapman and Hall Ltd. 589 pp., 365 illustrations, figures and tables. 6″ × 9″.) Price, $7.50.

This book is meant for the engineer who has to design or operate complete engineering plant systems. It deals mainly with the choice of electric motors and their associated control equipment to suit various classes of drive. The book is largely descriptive in nature, and contains many wiring diagrams, charts of performance and illustrations of the apparatus involved.

A. G. DOE.

CENTRIFUGAL AND AXIAL FLOW PUMPS. By A. S. Stepanoff. (New York: John Wiley and Sons Inc.; London: Chapman and Hall Ltd., 1948. 428 pp., many text-figures and diagrams, 6″ × 9″.) Price, $7.50.

First reaction to the Table of Contents is to doubt whether so much material can be satisfactorily presented in so small a space. More intimate reading reveals that skilful arrangement, clear concise statement and a production-line development of themes provides a successful solution. The author does not involve the reader in unnecessarily complex mathematics where simple directness will do a better job. A slight acquaintance with the elementary ideas of integration is about the heaviest demand made. Emphasis is throughout on fundamentals and examples of their application to the solution of the pump problem.

Outstanding sections deal with design of all types of centrifugal and axial flow pumps. The treatment of design data and practice is helpful as a primary guide. Examples of design and test results accent the treatment, and chapters on cavitation, special operating conditions, unstable characteristics, with a treatment of shaft design for critical speeds and the author's own diagram of centrifugal pump characteristics contribute largely to the book's utility. Well illustrated examples of typical installations, together with recent high-head sets, boiler, hot oil, circulation pumps, and deep well and submersible pumps are included in the survey. References are freely given at the end of each chapter.

The lack of numerical examples detracts from its value as a textbook for class purposes. The free use of italics to lend emphasis to important conclusions and arguments is to be praised, but it is unfortunate that some of the statements thus accented are wide generalizations which are only partly true. Thus there is a misleading statement on page 35, that with a forward-sloping vane the head increases with capacity, and that this condition cannot be realized even in an idealized pump, as flow cannot be started against a head higher than that at zero discharge. If, as is not unusual, the total opposing head is composed of static pressure difference plus pipe flow resistance in a long pipe line, such a pump can—theoretically at least—operate at its design point against a total head greater than its zero discharge head. In fact, on page 183, fig. 9-14, the author shows a set of curves of actual performance of pump impellers of different discharge angles: certainly none are forward-sloping vanes, but for some of them the peak of the head discharge curve is well removed from the shut-off head point.

On page 75, dealing with solid-liquid mixtures, the statement is made that solids cannot convert their kinetic energy into pressure energy. This is surely false. The only difference between an entrained solid and the entraining liquid in most pump applications is that of rigidity. The author is apparently thinking of diverging stream lines, and although a solid cannot diverge the fluid around it can and must. The process may not be highly efficient, but if the solid is to move in and with a fluid stream which is suffering retardation due to expanding boundaries, then its momentum must diminish and the pressure gradient in the direction of motion increase as a result. One cannot ignore the principle of conservation of momentum or Newton's Second Law. If increasing fluid pressure, together with viscous traction, both of which will increase the gradient, does not supply the necessary retarding force to the solid, it is difficult to see what does.

These faults, though making the book of less value for a student, still leave it a valuable book of general references.

K. R. M. Hart.

Soil Mechanics. By Donald W. Taylor. (New York: John Wiley and Sons; London: Chapman and Hall Ltd., 1948. 700 pp., many text-figures. 8½" × 5½".) Price, $6.00.

This book deals with the principles of soil mechanics as applied to foundations. The treatment of the theory is quite detailed, making it eminently suited as a textbook for students. Although emphasis is on theory, sufficient description is given of the usual soil tests and the interpretation of results from them to be of interest to practising engineers.

A feature is the author's treatment of seepage. The theory of two-dimensional flow is given successfully, using the simplest of mathematics, yet the explanation of the graphical construction of flow nets for isotropic and non-isotropic soils is particularly clear and convincing. The sections on shear strength and shear testing of soils have also been given a broader treatment that is to be expected. In these sections an idealized treatment is first given and then this oversimplified conception is modified by consideration of factors such as intergranular pressure, colloidal phenomena, consolidation pressure and degree of progressive action, to give a more rational explanation which is consistent with the behaviour of actual soils.

The text is well illustrated with worked examples. At the end of each chapter is a set of examples based on the previous theory. The author has presented a satisfying exposition of the fundamentals of soil mechanics which should fill a vacancy in the literature of the subject long felt by all teachers.

C. M. Gray.

Metallurgy

Modern Metallurgy of Alloys. By R. H. Harrington. (New York: John Wiley and Sons Inc.; London: Chapman and Hall Ltd., 1948. 209 pp., 49 text-figs., 30 tables. 5½" × 8½".) Price, $3.50.

The author of this book, R. H. Harrington, was formerly a member of the teaching staff of the University of Michigan and is now Research Metallurgist for the General Electric Company. It appears that his particular field of research has been precipitation hardening and the role of strain on precipitation reactions in alloys. Metallurgists often forget that, in consideration of condensed systems, they are neglecting one of the possible degrees of freedom, and if the author fails to present a completely satisfying treatment of this aspect, at least he is to be congratulated for directing our attention to it. This book covers the subject of strain, ageing and precipitation hardening fully and well.

In other directions, however, the book is not so satisfactory. It was written to fill the need the author feels for a logical and philosophical basis for the subject of metallurgy. He states: "The intent of this book is to supply a temporary foundation for this House (of Metallurgy)". The title is misleading, for the text does not give a general survey of the subject, but rather is the development of the author's ideas on a limited number of aspects of metallurgy.

One chapter deals with heat-treatment definitions, and although the general method of approach is novel and quite logical, yet the definitions themselves are unsatisfactory, and sometimes mutually incompatible.

Another chapter reclassifies the alloy systems according to equilibrium diagrams. Some of the classifications are admitted to be theoretically and actually impossible, yet they are included ". . . to meet the convention falsely established and falsely continued in almost all textbooks". This is surely a remarkable concession when presenting what "seems the most logical system of classification at this time".

The chapter on the Periodic Table contains a reclassification of the crystal structures, while the chapter on recent physics of alloys contains little more than a mention of the important British and American work in this field. The author carries his classification and coding to such an extent that the later chapters are little better than a mathematical puzzle.

The book is attractively got up, well printed on good paper, and well set out. The index is adequate, but there is no bibliography, and references in the text are far too infrequent. The book has been developed from a series of articles in "Steel Processing", and many loosely used words and ideas, and many inaccuracies that would pass unheeded in a series of popular articles, become very glaring when they are present in the serious discussion of a science like metallurgy.

J. G. McMaster.

Meteorology

Techniques of Observing the Weather. By B. C. Haynes. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall Ltd. 272 pp., 98 photographs and figs., 8½" × 5½".) Price: $4.00.

Intended for "high school and college courses in elementary meteorology and weather observing", this book is a pointer to the rapid growth in the United States of a meteorological profession largely independent of the official weather service. It covers the full range of routine meteorological observations used for forecasting purposes, including upper wind-finding techniques and radiosondes.

The emphasis is on formal instructions in the correct manner of making and recording weather observations rather than on physical explanations. The accepted observing methods and terminologies of several weather elements are necessarily conventional to some extent, in the interests of uniformity. These conventions are described in detail and copies of many official forms for recording weather data are reproduced. In an author who is the Chief of the Observations Section of the U.S. Weather Bureau, this emphasis is understandable, but it makes the book rather too much of the trade manual type, at least by our educational standards. Occasional tentatives at humanizing the subject, as for instance by the introduction of an historical note on the Beaufort wind force scale, do not help very much in this regard. Nor does the author's slight penchant for using more or less esoteric terms (aerial meteors; winds and tornadoes; lithometeors; dust and smoke; luminous meteors: rainbows and halos).

The instruments and practice described are naturally those of the U.S. Weather Bureau. Since details are treated rather than general principles, this text seems unlikely to find much application abroad: as yet there is little sign elsewhere of non-governmental agencies taking an interest in meteorology, and the official weather services normally prepare their own observing manuals and train their own observers.

The printing and illustrations are excellent. and there is a good balance between line drawings and photographs. Some useful conversion tables are included.

P. SQUIRES.

Miscellaneous

THE INTELLIGENT USE OF THE MICROSCOPE. By C. W. Olliver. (London: Chapman and Hall. 182 pp., 53 text-figures, 8½″ × 5½″.) English price: 12s. 6d.

Readers interested in works on microscopy will remember the large tomes of the earlier part of the century, masterpieces in their way, running into a thousand pages. Shorter manuals followed and there were always the pocket-book-type texts of the makers. Some twenty years ago a Scots professor and his teaching fellow brought to general notice the idea that the institution of lectures and practical work in microscopy was incumbent on university classes taking medical physics. They elaborated their lectures and notes into an illustrated booklet of less than eighty pages.

The latest developments of the microscope and the importance of photomicrography in medicine have so impressed the Nuffield School of Physic at Oxford that a lectureship in microscopy has been established there. From such an origin, and with a realization that the shorter treatises tend to leave out much relevant matter on pure microscopy that we had not time to digest from the superb large tomes, C. W. Olliver has produced a book upon *The Intelligent Use of the Microscope.*

In its one hundred and eighty pages it presents to the student in a most readable manner every conceivable item of interest that long experience with different types of microscopes and photomicrography would suggest. They are given adequately with diagrams and drawings. After reading the book the student, whether of medicine or otherwise, would feel that he could readily converse with the experienced artist in photomicrography with understanding. and that he was in a fair way to tackling special problems for himself. Although the author makes a point of this general method of approach, his work is not mere dictionary—sufficient material is presented to explain the reasons for the steps taken and the nature of the optical parts involved.

Commencing with the usual introduction on optical theory, the book deals with magnification, measurement of focal length, depth of focus and ultimately numerical aperture and coverglass thickness, including the Jackson lens corrector. Some of the best parts deal with illumination and colour values, in a most practical manner, especially the Kohler system. The many practical tips garnered over the years will surprise even an experienced microscopist. A good account is given of oblique light, with explanation of why many substage accessories of continental stands are obsolete. We agree with the choice of black spots in diatoms as a test of higher powers.

A useful chapter is given on blood counting devices, infra-red and ultra-violet photomicrography, and a paragraph on the electron microscope. The section on photomicrography is probably the best; all other discussions are made to lead up to this. Various types of microscopes for special purposes are alluded to and the prism binoculars. The book ends with modern research outfit.

A few obscurities and omissions are notable. On page 101 the author might have mentioned Watson's triple nosepiece with centring screws for each objective. In dealing with the inclined eyepiece on page 102, it is stated that an extension of tube length from 160 mm. to 210 mm. corresponds to a factor of 1·5 in the magnification, whereas the extension should surely be to 250 mm. On pages 46, 47 the Abbé condenser is described as having a numerical aperture, N.A., of 1·0 or less; but Abbé condensers are usually described with oil immersion, and thus as having N.A. of 1·2 to 1·4; only if used dry would the N.A. be under 1·0. Again, "an achromatic condenser of the preceding class (i.e., the Watson Holos Universal) can also be used as an oil immersion condenser and then has an N.A. of 1·3". This figure belongs to the special Watson

Holoscopic oil immersion, and while this delivers "dry" an aplanatic cone of 0·95 N.A., the "universal" condenser can scarcely deliver even with oil more N.A. than it is computed for. These few items do not detract from the real usefulness of the book.

O. LATHAM.

ARCHITECTURAL CONSTRUCTION. By Theodore Crane. (New York: John Wiley and Sons Inc.; London: Chapman and Hall Ltd. 414 pp., numerous illustrations, figures and tables. 9″ × 6″.) Price, $6.00.

This book is concerned principally with large buildings and the larger aspects of architectural construction. Lacking the designing data essential to the consulting civil engineer, it provides examples of many ways of handling a considerable proportion of the various problems confronting architects of buildings and their structures. The well-reasoned statements which are combined with the problems make clear the advantages and disadvantages of the solutions offered. These solutions should provide a mental stimulant to designers who know the frustration arising out of a limited choice of materials.

Much of the information in the chapter devoted to "Building Codes and Design Standards" is of value only to architects practising in America, although some of it should assist Australian architects in obtaining desirable results when building codes fail to provide rulings. The second chapter, on the "Choice of Framing Material", is one which, *mutatis mutandis*, has definite application in Australia. This subject is one which is generally neglected in works on architectural construction, probably on account of its controversial nature. Nevertheless, it is one which concerns every architect and engineer engaged upon industrial building. Similarly, the chapter on "Modular Design" will guide architects along the path which all know they should follow, but from which the majority tend to stray at an early stage in design. The result, far too often, is an unnecessarily expensive structural frame. The limiting conditions of practice in Australia somewhat reduce the value of this chapter.

Exhaustive consideration is given to the selection of floor and roof systems, with related information on insulation for sound and heat for single span structures of various sizes. Stone, reinforced concrete, steel and timber are compared. This particularly useful section shows clearly the progress of other countries. Applicable to all classes of building, the thought devoted to the selection of materials for walls is especially valuable. Again, related information is given as to the insulating properties of various structural systems, both in regard to heat and sound. Peculiarly, the last chapter is devoted to foundations. Soil loading tests and pressure bulb theories are explained clearly, but with little figuring. Illustrations are given of various systems of pile cantilever and spread footings.

E. L. THOMPSON.

Physics

THE CATHODE RAY OSCILLOGRAPH IN INDUSTRY. By W. Wilson, D.Sc. Third edition. (London: Chapman and Hall, Ltd. 1948. 252 pp., 198 photographs, text-figs. and diagrams, 8½″ × 5½″.) English price: 18s.

The scope of this book is restricted to the requirements of the engineer or physicist using the cathode ray oscillograph in industrial research. Television tubes, which form a distinct branch of the subject, are therefore excluded; but there is a chapter on the electron microscope, because of its increasing importance in solving industrial problems. The approach to the subject is essentially practical and non-mathematical, and material of purely historical or theoretical interest has been omitted. By this means the author has been able to devote more space to examples of the use of the oscillograph. The new edition differs from the previous one chiefly through some minor extensions and additions which have resulted from the release of information on radar research. A new appendix briefly covers some of the radar developments, with potential industrial applications, such as the plan position indicator, dark trace projection tubes, post-deflexion acceleration and screen magnification.

As the author points out, the use of the cathode ray oscillograph is no longer restricted to radio and electrical laboratories, but has spread to mechanical and civil engineering and to such fields as medical research. The contents of the book bear out this statement. The first section is given to familiarizing the reader with the instrument itself. Quite properly, the more elaborate metal types with associated pumps and cameras are treated as fully as the common evacuated glass tubes. Each has its own special advantages for special types of problem. A chapter describing accessory circuits, such as time bases, amplifiers, electronic switches and so on, is brief but should be adequate in a book of such type. After discussing the general characteristics of cathode ray oscillographs, the section concludes with a description of representative commercial instruments and their capabilities. The material is well illustrated with photographs.

The next section comprises the bulk of the book and collects a large number of applications in which the cathode ray oscillograph has special advantages. These are classified according to the type of deflexion required. Thus some tests need only one pair of deflecting plates. In others, such as in phase and frequency comparison, modulation, monitoring and such, both sets of plates are used dif-

ferentially. Cyclic phenomena requiring a time base are most common and are illustrated by applications to rotating machinery, mercury arc rectifiers, ionospheric research, supersonic flow detection, recurrent surge work and many other problems. The use of single sweep time bases is discussed in connexion with surge testing, circuit breaker operation and several medical applications. Bases other than time are required for tracing resonance curves, valve characteristics, iron hysteresis curves and other graphs. A chapter is given to the recording of mechanical pressures and strains using piezo-electric, condenser, variable resistance, induction and strain-gauge pressure converters. Examples are given of applications to noise and vibration testing, bomb pressure measurement and the tracing of the indicator diagrams of internal combustion engines. An interesting chapter follows on the electron microscope and the electron diffraction camera. Commercial instruments are described in detail and their performance is illustrated by reference to applications in chemistry, bacteriology and metallography.

The subject matter of this section is illustrated by many striking oscillograms from actual tests. References to the literature are given in most applications, but this practice might have been extended with advantage. The treatment of such a wide range of material in a volume of restricted size is necessarily concise, but it is accomplished without sacrifice of clarity. The book is recommended to those who may wish to obtain an understanding of the potentialities of this versatile instrument.

H. C. MINETT.

Physiology

COMPARATIVE PHYSIOLOGY. By Bradley T. Scheer. (New York: John Wiley and Sons Inc.; London: Chapman and Hall Ltd. 563 pp., 72 text figs. 5½″ × 8½″.) Price, $6.00.

"Comparative anatomy is the backbone of zoology." From the turn of the century the proponents of this view have been sceptical of the intrusion of newer fields of zoological study into courses in their departments. They have contended that comparative physiology and more recently animal ecology have yet to accredit themselves with the demonstration of clear cut principles which can serve as a basis of study. Any truth which such an opinion once had is becoming less applicable as modern reviews appear. Claude Bernard gave comparative physiology an objective to strive for in its first textbook, "Leçons sur les phenomenas de la vie communs aux animaux et aux vegetaux", published in 1879. Since then the accumulation of unrelated facts has often been more evident than the emergence of general principles. Within the last two decades, however, systematic reviews have appeared in specialized fields of comparative physiology such for example as the Cambridge series in comparative physiology, von Buddenbrock's German text of comparative physiology and the monographs of the Copenhagen laboratory of physiological zoology. For the English-speaking student there has been no one comprehensive text of a satisfactory nature. It is therefore with considerable interest and some scepticism that a zoologist approaches a book entitled "Comparative Physiology".

Scheer interprets the physiology of invertebrates and vertebrates in terms of evolutionary history and ecology, the two unifying concepts which Baldwin so successfully employed in his "Introduction to Comparative Biochemistry". For any two similar processes one seeks to know whether they are alike because the two organisms concerned are related or because they are subject to similar environmental influences. The result of this treatment is nothing less than exciting in some parts of the book: the account of the evolution of nutritive requirements is an example. On the other hand there are some functions which must await further investigation before it can be said that an evolutionary or ecological picture has yet emerged.

A vast amount of data has been brought together in this book together with an equally extensive and up-to-date bibliography. The major criticism must be directed to the particular arrangement of the material which the author has chosen. Chapter divisions are by phyla, there being seven chapters for invertebrates and two for vertebrates. A secondary classification subdivides each chapter under the functions of nutrition, respiration, excretion, intermediary metabolism, osmoregulation, neurophysiology, endocrinology, muscle metabolism, locomotion and behaviour. General comparative accounts are to be found in four places—the introductory chapter, at the end of each successive chapter, at the beginning of the two chapters entitled vertebrates and in a final summarizing chapter. The arrangement makes for considerable repetition but more seriously still it loses much in the evolutionary pattern which is revealed by functional relationships. With such an arrangement the necessity of a comprehensive index becomes imperative, and unfortunately a second major criticism concerns the index: it is quite inadequate. In an alternative treatment the primary classification could have been a functional one with secondary phylogenetic subdivisions.

It is not easy to understand the mode of selection of data incorporated in the introductory chapter. Pages 25 and 26 figure complex diagrams of the glycolytic and citric acid cycles, but discussion of the diagrams is delayed until page 424. In other instances the general account is to be found under a particular phylum. The various theories of nervous condition appear in the chapter on molluscs although a preceding chapter on coelenterates includes a useful review of

nervous conduction in that phylum. An equally good classification of the nutritive requirements of organisms appears in the chapter on protozoa. There appears to be little better reason for placing it there than the fact that the classification is a particularly appropriate adaptation of Doyle's classification of protozoan nutrition.

Studies on protozoa have provided much of the best data on the evolution of nutritive requirements, involving loss of ability to synthesize complex organic compounds. Speculations arising from this work receives support from Beadle's studies on the mould *Neurospora*. The different nutritive requirements of mutant strains demonstrate how a single gene mutation may be associated with the loss of a particular synthetic ability. Apart from the insects there is a large gap in our knowledge of the nutritive requirements of other invertebrate groups. But the data from groups even as widely separated as moulds, protozoa and insects provide ample evidence of the value of the comparative approach. It is more difficult to piece together a picture of the evolution of digestion. This is not treated as a whole in any one section of the book despite the numerous references to Yonge's classic work on marine invertebrates. For an account of the evolution of extracellular digestion the reader will find it necessary to refer to Yonge's reviews. No reference is made to Yonge's contention that proteins are digested intracellularly in the Lamellibranchs, nor to the more recent papers of Mansour-Bek which take issue with Yonge on this point. A comparative account of feeding mechanisms following Yonge's classification is delayed to the second-to-last chapter under vertebrates.

The sections on respiration do not present a synoptic picture of the evolution of the respiratory function of the blood, nor of the evolution of aerial from aquatic respiration. Within the limitations of particular phyla the latter problem is discussed. Here again in the discussion of respiration an unnecessary disjunction exists between closely linked aspects. The oxygen dissociation curve, for example, is introduced in relation to mollusc blood on page 182, but loading and unloading tensions are not defined until page 410.

Scattered links in the chain of nerve physiology are skilfully brought together as a sequence is traced from slow conducting pathways in the nerve net to the faster and more highly polarized system of higher organisms. The sections on chemical co-ordination in invertebrates provide up-to-date supplements to Hanström's book which even now is out of date. The discovery of an increasing number of functions assignable to the sinus gland of crustaceans and the corpus-allatum-cardiacum of insects provides an interesting analogy with the pituitary gland of vertebrates. It is becoming abundantly clear that ecologists of Arthropod classes must take cognizance of the role of these glands. There is evidence, for example, that an internal rhythm of activity in a number of crustaceans, diurnal in some species and possibly seasonal in others, is under the control of hormones. The identification of such physiological rhythms may have revolutionary significance to the ecologist, as significant as the recent identification of seasonal cycles in genetical composition of animal populations. No longer may the ecologist assume that his organisms are genetically or physiologically the same at different times of the year! A heap of problems on this borderland between ecology and physiology awaits investigation. Hormones involved in the metamiphoris of insects are only briefly considered in the book and without reference to modern work on the role of the brain and prothoracic glands in Lepidoptera. The related phenomenon of diapause which is significant in the regulation of seasonal cycles in numerous insects is not mentioned.

The sections on excretion might have been co-ordinated to a greater degree by emphasis on the evolution of uricotely and ureotely, and the treatment accorded to behaviour is rather too brief to be of much value.

In all, however, this latest work on comparative physiology testifies to Claude Bernard's prediction that the constancy of the internal physiological environment is the condition of free life. Comparative physiology traces out the evolution of homeostasis whereby the internal environment becomes increasingly independent of changes in external factors. If evolution can be said to have a direction there is evidence to suppose that it is toward a state of more complete homeostasis. Although the principles of evolution were originally discerned on an anatomical basis, the end point of evolution is physiological. Much remains to complete the picture within this framework. The book under review can only help to promote that end. It should find a place on the book shelves of senior students and research workers.

L. C. Birch.

Veterinary Science

Phenothiazine 1942–1946: A Review and Bibliography. By J. Tweedle Edwards and the Imperial Bureau of Agricultural Parasitology (Helminthology). (Imperial Agricultural Bureau Joint Publication No. 12.) 1947. Copies obtainable from the Liaison Officer, Commonwealth Agricultural Bureaux, 425 St. Kilda Road, Melbourne, S.C.2. Price: 5s.

This book reviews the literature on phenothiazine in veterinary medicine for 1942–46, and deals with pharmacology, toxicology and the clinical application of the drug. The drug behaves differently in different species of animals, so that it is essential to consider toxicity separately for the various species. Cattle and horses are the most susceptible of all domestic animals, but the reasons for this

are not at all clear. The difference between cattle and sheep is surprising, but recent studies in New Zealand by Clare (*Aust. Veter. J.*, 1947, 23, 340) suggest a reason for this difference. In cattle usually, and in sheep when a large dose is given, the conversion of phenothiazine sulphoxide to phenothiazone in the liver is not complete, so that the sulphoxide reaches the systemic circulation. Clare, Whitten and Filmer (ibid., p. 344) showed that the sulphoxide may enter the aqueous humor of the eye and thereby produce a state of photosensitivity to sunlight, leading in some cases to a severe keratitis. The effect of the obviously different metabolism of phenothiazine on toxic effects in cattle, apart from causing keratitis, has not been determined.

It has been suggested that constipation is conducive to phenothiazine poisoning, particularly in horses, but this is not supported by experimental or authoritative clinical evidence. It has also been suggested that the toxicity hazard is less if the dose is divided over several days, instead of being given at one time. Edwards points out that the daily divided dose was exactly what had been used in those human cases where toxic effects developed.

In the section on clinical application, the technique of administration, the text discusses the form of drug, preparation of patient, dose, effect of climate and farming practice, hazards and evaluation of results. The individual animals are then considered and there are tables to indicate the degrees of efficiency against the various species of nematodes and summaries of the literature on methods of administration and toxicity. There are brief sections on phenothiazine therapy in other animals, on the action of phenothiazine in non-helminthic diseases of domestic animals, and the use of phenothiazine in helminthiasis in man.

A bibliography follows for the years 1942–46, prepared by the Commonwealth Bureau of Agricultural Parasitology (Helminthology), and it is set down under the respective years.

H. McL. Gordon.

Zoology

An Introduction to Vertebrate Anatomy. By Harold Madison Messer. 1947. Revised edition. (New York: The Macmillan Company; London: Macmillan and Co. 475 pp., 397 text-figs., 5½″ × 8½″.) English price: 24s.

Nine years have now elapsed since the first edition of Harold Madison Messer's *An Introduction to Vertebrate Anatomy* appeared as a text-book offering a one-semester course for the students of Long Island University. In the revised edition the original title has been retained. The scope of the subject-matter, however, is more extensive and covers a wider field than the title suggests, since an account of the Protochordates is included and provides an excellent foreword to the Vertebrate sections of the book.

In the preparation of the revised edition the author has sought, firstly, to make the text somewhat more complete and comprehensive; secondly, to improve and increase the number of illustrations; and finally, to correct or qualify certain statements which recent investigations have shown to be questionable. The author has succeeded admirably in this task and the book now emerges as an up-to-date account of comparative chordate anatomy in which the text is about ten per cent. larger than in the 1938 edition.

Although the arrangement of the subject-matter is conventional, the author has nevertheless produced a very readable and well-illustrated account of the comparative anatomy of all groups of the Chordates, from the Hemichorda, Urochorda and Cephalochorda to the Mammalia. Professor Messer is fully alive to the fact that while the salient features of anatomical descriptions remain unchanged for the most part through the years, the interpretation of structure is often open to criticism. A number of such cases are briefly considered and discussed in the revised edition.

The text is clearly and concisely written, and each chapter ends with an excellent summary. There are, of course, departures from English usage and terminology, but in most instances these are of a quite minor character. For example, in the introductory chapter on the chordates, the distinction between gill-clefts and visceral clefts (minus gills) is not drawn; consequently, in *Amphioxus* the clefts perforating the lateral walls of the pharynx are referred to as "gill-slits". The chapter on early vertebrate development could well be expanded to include a brief description of the "presumptive areas", while the section concerning the origin, structure and functions of the fœtal membranes could be dealt with more fully from the evolutionary point of view. A passing reference to placentation in the viviparous lizards would not be out of place. These are small matters when the general excellence of the text is taken into consideration. If the author's lectures are as satisfactory as his text-book, then his students are indeed fortunate.

Although comparative anatomy is essentially the study of structure, the functions of the organ-systems have not been neglected. There are also good chapters on the nervous system and the ductless glands, followed by an account of the origin and evolution of the vertebrates. The book, which is strongly and most attractively bound, contains a bibliography, a glossary and a very extensive index. The typeface is particularly clear and all the drawings have the added advantage that each structure is labelled with its name in full.

E. A. Briggs.

The Australian Journal of Science

VOL. XI 21 December, 1948 No. 3

Social Relations of Science

I. UNESCO PROGRAMME.*

Popularization of the Social Implications.

The deep social implications of science were appreciated as far back as the 17th century by Francis Bacon. Through the centuries the powers of the scientific method and attitude have been recognized by more and more men, until in the 19th century the belief became common that science inevitably and rapidly leads to progress. This belief was greatly shaken by the utilization of science on a greater and greater scale as a powerful tool of modern warfare; so that science is considered by many serious persons to be a menace to civilization rather than an essentially progressive force. The frequent tendency to apply science for the development of gadgets rather than as a basis for general improvement of the welfare of mankind is believed by others to be a clear sign of international immaturity. There is a growing recognition, however, of the fact that scientific knowledge itself is to a large extent basically neutral, both morally and socially, and can be used either for constructive or destructive purposes. The work of the United Nations and its agencies depends greatly upon the interpretations placed on scientific and technological developments—including those that have accumulated for several decades as well as recent developments.

At present there exists no effective collection of relevant information on which decisions for action may be drawn, or which could be enlarged and corrected in the light of experience. The need to analyse, collect and correlate such information has been recognized and has to some extent been met in various countries. Both the British and the American Associations for the Advancement of Science, and the Editorial Council for Popular Scientific Publications in the U.S.S.R., have made some advance. The I.C.S.U. has acted through its Committee on Science and its Social Relations, the I.U. of the History of Philosophy of Science has acted through its Commission for the History of the Social Relations of Science, the World Engineering Conference has set up a Committee on the Social and International Effects of Technological Developments; the Emergency Committee of Atomic Scientists (U.S.A.) and the World Federation of Scientific Workers have each given attention to the problem. Essays and books have been written on the subject by qualified individuals.

Advisory Panels.

Preparatory to the Mexico City Conference of November 1947, UNESCO prepared a set of questions for consideration and clarification, which it placed before a Panel of European Experts and a Panel of North American Experts. The European Panel met in Paris on 6–7 October, 1947, under the Chairmanship of Professor M. Florkin, of the chair of Biochemistry in the University of Liège. The Rapporteur was Professor Eric Ashby, formerly of Sydney and now of the Botany Department of the University of Manchester. The Panel included Professor P. A. Montel (Mathematics, Paris); Professor J. M. Burgers, representing the C.S.S.R. of the I.C.S.U.; J. G. Crowther, as Secretary of the Society of Visiting Scientists, London; scientific journalists from Paris, London, Cracow, Copenhagen; and Mrs. Nesta Pain, of the B.B.C. Several organizations sent observers.

The North American Panel met in New York on 30–31 October, 1947, under the chairmanship of Professor R. S. Lynd, of the chair of Sociology in Columbia University. The Vice-Chairman was Professor W. F. Ogburn, of the chair of Sociology in Chicago, and the Rapporteur was Professor D. Y. Solandt, of the chair of Physiological Hygiene in Toronto. The Panel included Professor Robert McIver (Political Philosophy, Columbia); Professor F. S. C. Northrop (Philosophy, Yale); D.

* This JOURNAL, *10* (1948), 127, 163; *11* (1948), 2, 43.

Harlow Shapley (Harvard College Observatory); F. B. Turck (Engineers' Joint Council, N.Y.); Watson Davis (Director of Science Service, Washington); David Dietz (Science Editor, Scripps-Howard Newspapers); Waldemar Kaempffert (Science Editor, New York Times); Ross McLean (National Film Board of Canada); John Pfeiffer (Columbia Broadcasting System). It will be noted that the balance between science and sociology was different in the two panels.

The Panels recommended that UNESCO should prepare and circulate a report on the work of national organizations already in existence for the popularization of science and should offer to send experts to advise any country wishing to set up an organization for the popularization of science. It was recommended that UNESCO should stimulate and encourage continuing surveys and researches into the effectiveness of popularization among different peoples, having regard to emotional resistances, prevailing traditional beliefs and the particular desires for knowledge.

The European Panel felt that UNESCO should not itself undertake the responsibility of preparing or obtaining interpretations of the international and social implications of science; but the North American Panel preferred to express no opinion on this point. Both Panels thought that UNESCO should stimulate the preparation and exchange of material concerning the popularization of science by various international and national non-governmental agencies, securing the cooperation of the I.C.S.U. and other appropriate bodies, whose enquiries and surveys it should co-ordinate. It was proposed that UNESCO should establish fellowships for basic research on the social relations of science as shown in recent and earlier history, should set up pilot studies in particular countries or in particular areas of science, and should otherwise stimulate and promote such research where existing agencies of research are found to be inadequate to furnish the desired knowledge. Bibliographies of books, articles, films, radioscripts and other material on the social implication of science should be arranged and widely distributed.

The two Panels were of the opinion that
secrecy has a very retrograde effect upon the progress of fundamental science,
and they recommended that UNESCO should
take all action within its power to abolish secrecy or to reduce its effects in the field of fundamental scientific research.

It was recommended that UNESCO should take every possible step to assist the widest propagation of an understanding of the scientific method and outlook, especially in view of its relevance to popular political thought and action in all countries. To make the influence of the scientific attitude effective, the North American Panel believed that it is necessary to propagate not only an understanding of the scientific method as such, but also objective information about the various cultures, social systems and anthropological groups of the world.

Topics for Study.

It was suggested to the Panels by the Secretariat that the most critical topics whose social implications should be collated and popularized included:

relations of agriculture, soil erosion and population growth;
health and industrial aspects of nuclear energy;
conservation and utilization of natural resources;
psychology and war;
psychology and moral codes;
mechanized cotton picking;
housing and town planning;
philosophy and general implications of modern science (astronomy, physics, biology, etc.);
relations between science and art;
nutrition as a science;
new drugs and medical methods;
air transportation;
implications of evolutionary theory upon social theory;
synthetic rubber and petrol;
mass production.

The European Panel endorsed this list and added:

applications of modern science to war;
influence of mechanization in industry;
applications of scientific psychology to the organization of social and international life;
the role of private, relative to governmental, enterprise in the development and application of scientific discoveries;
organizing and financing of science;
computing machinery.

The North American Panel, in place of both of these lists, substituted the following as the most critical topics:

- the value of international cooperation in scientific studies;
- the interrelation of agriculture, soil erosion and population;
- the utilization and conservation of resources;
- the more adequate use of modern medicine for social welfare;
- the health and industrial aspects of nuclear energy;
- the social conditions requisite for the freest development and use of scientific enquiry;
- the application of knowledge of human behaviour to the organization of peace and international welfare.

Professor W. F. Ogburn dissociated himself from this selection, failing more adequate time for consideration of criteria affecting priorities in such a list; he later furnished an extended statement on the subject. In the course of his statement he suggested the following as key topics which might be picked out if so necessitated by limitation of funds and of time:

- the influence of aviation upon internationalism;
- probable national changes to be occasioned by atomic energy;
- the consequences to national power of the spread of the "industrial revolution" to various States;
- the social effect of the biological discovery of the date of ovulation in women;
- the effect upon health and happiness of the various scientific discoveries;
- the possible effects of the communication inventions on the understanding of peoples;
- the effect of science on decision making;
- a dissemination of a year-by-year inventory of the uses of new inventions and scientific discoveries.

Organization for Popularization.

The two Panels then proceeded to answer the question of how the different branches of mass media should be used on an international scale for the purpose considered. Among a long list of recommendations the following were included:

- drawing the attention of information services to the many possibilities of popularizing science;
- need of educational agencies to train science writers;
- an international organization of science journalists;
- institutions of popular-exhibition nature such as the *Palais de la Découverte*, Paris;
- development of junior science clubs in schools and among adult groups, with prospect of national and international organization;
- conference of publishers of low-priced books;
- production and distribution of scientific films;
- production of radio features on science implications;
- facilities for exchange of such radio programmes;
- formation of scientific book clubs;
- yearly prizes for scientific journalism;
- yearly prizes to scientists by newspapers.

The European Panel added a memorandum which pointed out that there are two reasons why the social implications of science must be worked out in detail. Firstly, it is necessary to demonstrate to scientists themselves the extent and exact nature of the social implications of science. They are not evident and are frequently so obscure that many scientists still deny their existence or their importance. In the traditional scientists' view, science has *no* social implications, and studies have been carried out with the intent of proving that science is an autonomous logical structure of ideas, with no social relations or with relations of minor importance. Without realization of the social implications of one's work there can be no full realization of one's social responsibilities. Secondly, the wider public can see in a general way that science has social implications, but is baffled when trying to interpret these relations in precise detail and in particular cases. It is not possible to keep the public acquainted with the implications of science unless these are being worked out and demonstrated by research workers in the social relations of science.

The creation of a corpus of proved and scholarly knowledge on the social relations of science is therefore essential. For this purpose a new kind of research worker is required. He would collect the information on the new developments in science and scientific institutions, analyse it and explain its social significance. It is not sufficient that such enquiries should be carried out by busy specialists in physics or biology in their spare time. They must be done in a professional manner. Such research workers would be professional scholars, not writers for the press: they would provide the material which science writers could adapt for public consumption. The European Panel urged the formation of at least one University Department for the Social Relations of Science in each country of major significance: it believed that the creation of the new profession is essential for the smooth functioning, and indeed the safety, of modern society.

In May, 1948, UNESCO issued to member-States a memorandum on the organization of group discussions on the social implications of science. Suggested subjects for discussion were telecommunications, aviation, scientific improvements in agriculture, substitute products in applied chemistry, genetics. The collected material will be brought to the attention of the United Nations.

II. The International Unions.

I.C.S.U. Committee on Science and its Social Relations.

The C.S.S.R. met in Paris on 15 and 16 June, 1948. It decided that in its opinion the most urgent problems of the social relations of science today are:

(*a*) the dangers threatening science from the fact that research in large measure has become dependent on military sources and on industry for its finance;

(*b*) the way in which results of science are actually introduced into society.

The Committee points out that the actual problems involved in all social relations of science are problems involving man's attitude to scientific knowledge and to its application, in particular to the power given by science. The seriousness of these problems makes necessary an investigation in which psychology, social science, economics and juridical science should be called to help, while on the other side attention must be given also to the medical, agricultural and engineering sciences. It is felt that the creation of international organizations in the medical and engineering sciences would be of great help in attacking the problems. It is anticipated that the problem will be attacked by the I.C.S.U. jointly with UNESCO, the World Federation of Scientific Workers and other bodies.

A Charter for Scientists.

The Committee has issued the following declaration:

"The prominent position held at present by science in society, and the rapid transformation of the world through the application of science, carry with them for scientific workers special obligations over and above the ordinary duties of citizenship. Besides this the scientific worker has special responsibilities, since he or she has the possibility of obtaining information not readily available to the average citizen. It thus becomes the DUTY of the scientist to

(*a*) maintain a spirit of frankness, honesty, integrity and cooperation, and to work for international understanding;

(*b*) consciously examine the meaning and purposes of the work that he or she is performing;

(*c*) when in the service of others, enquire into the purpose for which the work is being done and the moral issues that may be involved;

(*d*) promote the development of science in the way most beneficial to mankind and exert his or her influence as far as possible to prevent its misuse;

(*e*) assist in the education of the people and the government in the purposes and the achievements of science."

In order to fulfil these obligations it is necessary to claim certain RIGHTS for scientists, the principal ones of which are:

(i) freedom of publication and the utmost freedom to discuss one's work with other scientists;

(ii) economic security and the right to participate freely in all activities permitted to all citizens;

(iii) the possibility of obtaining information about the purposes for which his or her work is being done.

War and Peace.

The Committee calls the attention of all scientists to the dangers which threaten the freedom of science through the increasing military influence on scientific research. This influence sooner or later through its secrecy restrictions will lead to the abrogation of the traditional freedom of expression and of publication, and result in directed research not planned primarily for the benefit of science and mankind but rather for its destruction.

The opinions of scientists are sought as to (i) the measure in which the methods of international scientific work contribute to the creation of an international spirit and to the maintenance of peace; (ii) the ways in which scientific organizations and scientists could intensify their activities for the maintenance of peace.

The Human Factor.

In giving attention to man himself as a fundamental unit of society, in the social relations of science, it is necessary to consider:

(i) the scientist before society;
(ii) the changes introduced in human societies through the technological developments of science;
(iii) the antagonisms between biological order and social order.

As regards the first, a CHARTER for Scientists has been given above and attention has been drawn to the dangers of subvention from military sources. As regards the second, investigation might be undertaken upon the effects of the introduction into society of knowledge concerning subjects such as:

(*a*) vitamins;
(*b*) new races of wheat and other food grains;
(*c*) artificial insemination;
(*d*) new forms of artificial illumination;
(*e*) television;
(*f*) products derived from nylon;
(*g*) aspirin, sulphamides, antibiotics, etc.;
(*h*) the medical applications of artificial radio-active elements.

To these may be added similar subjects listed by UNESCO (see above, pages 72-73), including:

(*i*) telecommunications;
(*j*) aviation;
(*k*) scientific improvements in agriculture;
(*l*) substitute products in applied chemistry;
(*m*) genetics.

The third study—that of antagonisms between human biology and society—is one for conference between specialists in biology, sociology and psychology.

The Committee forwarded its resolutions for approval by the September meeting of the Executive Council of the I.C.S.U. and took preparatory steps to give effect to the enquiries and consultations indicated in its findings.

I.U. History of Science.

The meeting of the C.S.S.R. was followed, on June 17 and 18, by a meeting of the Commission for the History of the Social Relations of Science, established by the International Union of the History of Science. The Commission decided upon immediate publication, in response to a request from UNESCO, of an essay upon the importance of social relations of science and the ways in which historical studies can help; proposing problems in the mutual effects of science and society. This is to be followed by the publication, in 1950, of a collective volume of essays upon Science and Society through the Ages.

III. B.B.C. TALK.

(The text of a talk given in the Home Universities Session of the B.B.C. by Professor BOYCE GIBSON on 4 August, 1948.*)

There exists in Western Europe, and in its orbit overseas, a long tradition which is most conveniently known as "humanism". The centre of it is a deep regard for the individual human person. It stands for the fullest possible expression of his varied and spontaneous activities, and, in consequence, for tolerance and kindliness, for the rational adjustment of differences, for mutual frankness and mutual esteem: each man dealing with every other "in every case as an end, never as a means only".

Though still strong, this tradition has been losing hold; and it is widely held that science and technology are to blame. That is a mistake. The decline of the humane tradition is due not to the rise of science, but to the failure of its own philosophy. The old humanism has been challenged by a new philosophy of collective man, smuggling its contraband under the humanist flag—a philosophy in which the individual human being, with his irreplaceable hopes and fears, oddities and originalities, is sacrificed to a terrifying abstraction called "humanity". The worst that can be said of science and technology is that they have not resisted this philosophy as they might have done. They do not in themselves encourage it and they have everything to lose from it.

It is sometimes said that science, though not directly responsible, is indirectly to blame for having no sense of values: thus leaving a vacuum into which the counter-values of collective man rush without resistance. To this it will be replied that science has a sense of values, though not one which can embrace the whole field of living; and that this sense of values, as far as it goes, should incline it to come out on the side of the humane tradition.

The scientist proceeds by way of hypothesis and experiment, and his object is to find out

* Abstracted from the Melbourne *University Gazette*, 4, 22 October 1948, 82.

what correlations actually do prevail between one kind of event and another. Austere and detached, he allows no passion or interest to stand in his way; and his success in neutralizing them is one of the triumphs of civilization. Thus, when he is confronted by mass pressures, he cannot yield without giving up his reason for existence. Even when, for what are called practical reasons, he is requested to do the wrong things first, there is a certain sense of strain. There is a good deal of contemporary blather about the "social function of science"—which means that science is to subordinate itself to more or less dubious social purposes. Actually science has in it a far higher integrity than any society, existing or projected. Science is one of the things society exists to maintain. To value it for its social functions is to put the cart before the horse. Quite apart from what it leads to, it is valuable for what it *is*.

But science, though an indispensable ingredient in the good life, is not the whole of it, and it cannot afford to be indifferent to the impact upon it of other human activities. This is particularly clear when we pass from pure science to technology.

The oldest of the technical studies, medicine, being concerned with the relief of suffering and the promotion of vital activities in individuals, is linked intrinsically to the humane tradition. The physical and engineering technologists are less fortunate. They find themselves more and more in the service of those large aggregations of power in the face of which the humane tradition has to be constantly vigilant—especially when they bring it gifts. The technologist has therefore to act as a citizen in defence of his calling as a scientist either by opposing accumulation of power or at least by ensuring that it is properly responsive to individual criticism. Part of the humane tradition is the continual reassessment of social ends. The more the technologist has to serve them, the more carefully is he called upon to scrutinize them.

Here we come to the social sciences. In this field, in particular, science needs to assert its integrity against social ends, for those who hold strong views about social ends generally prefer them to be unexamined. Here the social sciences are very much on the side of the angels. They are, however, tempted to sin against the humane tradition in a different way. They are tempted to think that their statistics, averages, generalizations and cross-sections are the whole truth about human beings. If that is what they think, they misconceive their own procedure. What scientists are doing—and it is highly illuminating—is to disclose the constant characteristics of human situations. Each of those situations, however, and each participant in them, is peculiar and personal. Social scientists who remember this have a leading part to play in defence of the humane tradition. Those who forget it may easily sell the pass: not because they are not good scientists, but because they are bad philosophers.

To conclude, science is part of the humane tradition; as such, it has an integrity which it must safeguard, both by exhibiting it on all occasions and by opposing social tendencies which seek to constrain it; only in so far as it has failed in these tasks is it responsible for the decline of the tradition to which it belongs.

(The Social Implications of Science will be discussed at the Pacific Congress. See below, p. 81.)

A Biological View on Instincts

A. A. ABBIE*

The subject of instincts is of interest to biologists, both because the working of instinct is everywhere so obvious to him and because instincts provide the main, or sole, driving force behind all animal activity. There is still, unfortunately, a good deal of dispute as to what constitutes an instinct, and much difference of opinion over how many instincts there are. Woodworth (1937), indeed, would abandon the term instinct as unnecessarily productive of confusion and proposes such alternatives as unlearnt reaction or unlearnt response; but the substitution of one name for another does not contribute towards a solution.

The generally accepted idea that certain inborn, purposive, but unlearnt responses are an expression of instinct need give rise to no confusion; this comes only from failure to distinguish learnt from unlearnt. Moreover, just because they are inborn, all instinctive reactions are served by a completely adequate set of inherent reflexes. Such reflexes, provided

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A paper given at the Fourth Annual Congress of the British Psychological Society (Australian Branch) in Adelaide on 25 August, 1948.

they are not too seriously hampered by other factors—as they very frequently are in man—will always produce the appropriate response proper to any particular animal under some particular set of conditions. The number of instincts identified by different observers differs widely. Representative samples are fourteen for McDougall (1926), eight for Woodworth and four for Trotter (1940). But, however elaborate the lists may be, and however they differ in detail, they all agree in including two—self-preservation and reproduction. There are some psychologists who maintain that these are the only two.

When a biologist gets an opportunity to step back from his immediate preoccupations and survey living matter as a whole he inevitably becomes impressed by the underlying common drive that characterizes all living activity. The outcome of this drive is that life, in the words of a well-known advertisement, "keeps on keeping on". That is to say that all living matter, irrespective of what guise it appears in, where it finds itself or what disabilities it suffers, is organized solely for the purpose of maintaining itself as a going concern. This is summed up in the term "struggle for existence" and it is displayed in two ways: one for the individual and one for the group to which the individual belongs. The major concern of the individual is to preserve its own integrity in the face of constant attack by climate, disease, competitors, enemies, and so on. That is the personal struggle for existence—self-preservation. But there comes a time when the powers of resistance wane and the individual succumbs to one or other of its enemies. It usually has the capacity to split off part of itself to form a new individual, thus securing the other aspect of "keeping on" by group preservation—reproduction. Self-preservation and reproduction have maintained life upon this earth for some thousand million years and the objective biologist can find no other purpose in living activity than to continue to maintain life by precisely the same mechanisms for as much longer as possible.

The majority of people would argue that while this may be so for other animals it is not the whole story as it concerns man. Man is undoubtedly an animal the same as any other: he may be more, but most would agree that he does not differ essentially from the others in the fundamentals of life. Certainly, man stands at the top of the evolutionary scale now, but that is not necessarily the final arrangement; indeed, as shown elsewhere (Abbie, 1945, 1947, 1948), man himself is undergoing active physical evolution today, and perhaps more rapidly than at any other time in his history. Moreover, the evolutionary scale must not be looked upon as a simple, straight ladder leading from viruses to man. It should, rather, be likened to a spiral staircase in which every turn is a duplicate of the one before, but at a higher level of organization. The essential of each turn is simple survival, mediated by self-preservation and reproduction. That applies equally to the turn which supports man, otherwise there would be no man. Life—human or other—either *is* or *it isn't* and, if *it isn't*, discussions of this sort would be worse than academic—they would be impossible.

Hence most biologists would prefer to support those psychologists who require only the two instincts of self-preservation and reproduction. The longest list of instincts and the plethora of emotions traditionally associated with them can be expressed in terms of these two alone. Many, perhaps most, psychologists would regard such simplification as naïve and misleading. Freud (1922), however, goes further and reduces virtually all human activity to terms solely of sex. There seem to be two main reasons for his attitude. One is, as others have pointed out, that the particular Viennese environment in which Freud elaborated his views might well have led him to over-emphasize the sexual element in mental disorder. The other reason is probably because life in a civilized community does not generally contain any obviously serious threat to personal security—on the contrary, it is designed expressly to foster security; but civilized life does oppose many barriers to adequate satisfaction of the sexual urge, which then tends to become an unduly prominent source of trouble.

There would probably be no general disagreement with the view that modern civilization is distinguished by a very elaborate superstructure which largely obscures the simple biological foundations upon which its survival ultimately depends. This superstructure has become so imposing, indeed, that it inevitably lends some support to the view that there is a great deal more to human life than mere existence and perpetuation. Now it is just over this great deal more—that is, the details of the superstructure—that the sharpest, if not the only, controversies arise; for there is little dispute over the fundamentals of self-preservation and reproduction. It is interesting to seek some clue as to why this should be, and such a clue appears to emerge from the train of observation and reasoning that led Trotter (1940) to formulate his views on what he called the herd instinct.

Trotter was very impressed with the energy with which humans conduct their social affairs, and particularly with the passion, often wholly irrational, with which they defend their institutions. He felt that such passion could come only from instinctive urge and he sought a criterion by which he could identify such an instinct if he found it. The criterion he adopted was the *selbsverständlich* principle—the *a priori* synthesis of William James (1890). According to this, what is the obvious thing to do, what activity admits of no doubt in the mind of the doer, is instinctive. It is clear that the obvious thing to do is the theme which pervades our whole social system, and Trotter

felt that here was the touchstone he had been seeking. Thus he decided that there is an instinct that drives men and some, but not all, animals to associate with their fellows: this is the gregarious, or herd, instinct. Trotter, however, was not wholly uncritical of James's definition. He saw that what is the obvious thing to one person is not necessarily so to others, and he remarked that that applies particularly to abstract conceptions of religion, justice, honour, and so on. Is there, for example, one instinct to make some people Roman Catholics and another to make others Protestants? It is scarcely conceivable; yet nobody would deny the emotional force that may be aroused on behalf of either belief. In these doubts Trotter held the solution to the problem. But the explanation was then (1908) only just emerging from the laboratory, and when this explanation became famous he failed to recognize it.

Trotter's views have been summarized elsewhere (Abbie, 1941): here one may be content to point out that they were elaborated over a period of eleven years (1908–1919) and that in the outcome his reasoning and conclusions found considerable justification in the events of a period which included two world wars separated by a very uneasy interval. Trotter's views are, then, entitled to considerable respect and one need not here criticize either his reasoning or his conclusions, but rather question the major premises upon which they are founded.

Trotter freely assumes an inborn tendency for humans to congregate. That seems self-evident from observations on social communities; but such observations give no clue to the mental activities of those born outside communities, and are not necessarily valid evidence that gregariousness is inborn and unlearnt. On the contrary, even children born into a community are notoriously egocentric and anti-social until they are taught how to behave: that is, how to behave according to a particular code, which may be quite different from the code of any other community. The individual is born into an organization already in being: he learns group lore at his mother's knee and, knowing no other, comes to look upon that special community as the natural environment, separation from which engenders loneliness and fear. It is the group mind, the voice of the community, which implants its own particular code of behaviour by a system of rewards and punishments, and the arbitrary standard so instilled becomes the conscience against which the individual learns either to esteem or deplore his own thoughts and actions.

The various groups of Australian aborigines offer a good example of the different possibilities of social development for, as Baldwin Spencer (1928) and others have shown, they range from the wretched, solitary, myall families of the arid west through all grades up to the elaborately organized tribes of the more favoured parts of the country. If there were an instinctive urge to herding there should be no solitary peoples; but they exist and do, in fact, appear to reflect the existence of very early man, whose remains are generally found in widely scattered, solitary sites. Further, if the urge to herding were universal, the organization of the various tribes should be fairly closely similar, but they differ enormously. The same thing applies to other peoples: the differences between them are much less physical and mental than social. There are, of course, some gross physical differences between the major ethnological groups; but in a continent like Europe, where war, migration and intermarriage for thousands of years have obliterated all possible basic physical differences, we still find that closely neighbouring countries differ very markedly in social behaviour and outlook. These superficial differences attract the superficial observer, who attributes them to racial differences. But Europe contains no distinct races at all; it only has so many different groups of people brought up to observe so many different codes. A child transplanted early enough from one group to another will become indistinguishable from other members of the new group; it may even run the risk of being considered quite immoral by the members of its original group.

There is nothing inherent in all this except the capacity for learning and, as is well known, groups can be led into blind adherence to the most fantastic beliefs if only their training is early and thorough enough. Clearly, then, social behaviour, which is the overt expression of herding, is far from being inborn and unlearnt; and if the expression of gregariousness does not conform to our definition of instinctive behaviour it seems highly unlikely that gregariousness is itself an instinct. For the responses of the so-called gregarious instinct betray none of the uniformity and certainty of the responses which characterize human self-preservative and sexual instincts. It will be recalled that the obvious thing to do is the theme which pervades all social behaviour, and that it applies particularly, if not exclusively, to abstract conceptions of religion, honour, justice, and so on. Yet, as Trotter observed and as emphasized here, these are the very things which are not universal: they differ markedly — sometimes violently—from group to group and from age to age. Moreover, they must be inculcated at each new generation by a definite system of punishments and rewards.

All the characteristic manifestations of social behaviour have been learnt, great numbers of people have managed very well without them, and not infrequently individuals or groups of individuals revolt when they find a particular system too oppressive. For these reasons one feels that there is no such thing as a gregarious or herd instinct, for it seems clear that all the activities of herding are purely conditioned responses (this term is preferable to con-

ditioned reflexes, which is self-contradictory). Nevertheless, there is no denying the force with which social institutions are supported and it is necessary to seek the origin of this force.

It must by now be clear that the origin of this force is to be found in the self-preservative instinct. People herd together, often to their own serious inconvenience, for mutual protection. In return they pay some respect to authority and to the rights of the other members of the group. Such obligations are binding only within the group, but they may be extended to other groups in return for similar concessions. It seems evident that it is the self-preservative instinct which drives groups to defend with such vigour both themselves and the social institutions upon which they believe their safety depends. The same instinct ensures that the training, or conditioning, of the young is towards the same end. Similarly, communal lore is taught at the mother's knee, for women have considerably more to fear from social disintegration than have men.

The problem of such things as honour, justice, religion, which are very important factors in communal life, still remains. It is evident that these belong to the superstructure of social existence, and it is over precisely these conceptions that opinions and beliefs differ most violently. In other words, they arise purely from group conditioning during childhood. A little consideration will disclose that the differing views upon these abstract conceptions depend largely, if not entirely, upon different views on social status and religion. Ideas on social status and religion are closely interwoven and it is profitable to glance briefly at their origin.

This matter has been discussed in more detail elsewhere (Abbie, 1941), so that it will suffice here to note the major steps in religious evolution. The beginning was almost certainly a magical animistic and polytheistic system which peopled all the surrounding natural objects with malignant supernatural beings: this idea inevitably raised a privileged caste in the witchdoctors who claimed the power to protect men against such evil influences. Next came the conception of immortality—first of the ruler, later of his immediate associates, and finally of the people as a whole (Elliot Smith, 1930): this conception was derived basically from primitive ideas on the supposed supernatural powers of the ruler and his family and it enhanced the privileged position of both the ruling caste and the priesthood that served it. Then appeared the difficult abstract conception of a single, inscrutable, omnipotent God—an idea which may have had its origin in the East but was most explicitly formulated by the heretic pharoah, Akhnaton, of the 18th Dynasty (Weigall, 1934) and was disseminated largely by the wanderings of the Jews. Last, some 1,500 years later, Christianity attempted—but without much real success in the outcome—to dissociate the religious conception from the idea of social status and privilege and extend the benefits of religion to everyone without discrimination. More or less pure examples of each of these stages can still be found today, but in most Christian communities, at least, some aspects of all of them have become incorporated in a single complex religious system.

It will be noted that the original system derived its force from fear and thus gained its support from the self-preservative instinct. The later conception of immortality makes an even greater appeal to this instinct, for it promises to extend personal survi l indefinitely. The subsequent developments of monotheism and Christianity have elevated and purified the whole religious conception enormously, but they still derive their ultimate appeal from the offer of immortality. Since social status and the accepted religion own a common origin, they have always supplied mutual support; for it is easy to argue that a threat to one endangers the stability of the other and so the immortal hopes of everybody. A community organized upon the socio-religious basis outlined draws inevitably its major customs and beliefs from the same source; and, even where the matter of social status has been adjusted from time to time and the priesthood has lost much of its secular power, the chief expressions of the original custom and belief persist. That must be so, for, in the absence of all else, surviving custom and belief—however disguised as codes of honour, justice, and so on—offer the only prospect of preserving the identity and stability of the group and the safety of its members. Therefore, every different group will defend its own particular code to the utmost—usually in complete ignorance of the origin of what it defends; and the ultimate drive comes from the self-preservative instinct of the individuals whose personal security is at stake.

Because each community has followed its own line of development it has evolved its own particular set of customs and beliefs which differ to a greater or lesser degree from those evolved by any other community. Because most communities fear that danger to the tiniest arbitrary detail of procedure risks the stability of their whole edifice and threatens the security and, far more, the immortality of the individual, every tiny detail is defended to the utmost. That is why disputes have raged so violently between community and community, between parts of communities, and between individuals, over what now appear to us trivialities—mere points of interpretation. In the matter of personal survival no detail is trivial: these are articles of belief which are not susceptible to proof or disproof, and they engage the full force of an enormously enhanced self-preservative instinct—enhanced because the prize is infinitely more precious than mere life: it contains the promise of personal survival for ever.

It seems, then, that the vast superstructure of civilized life rests mainly upon ideas on social status and religion, and that these, in their turn, depend upon a system of conditioning which derives its force from the self-preservative instinct. Thus we may give assent to Trotter's assertion that the force behind social behaviour is instinctive. He was wrong only in seeking a special instinct. Self-preservation supplies all the energy required.

The opinion is thus that the whole mass of religion, belief and custom that characterizes social behaviour represents a series of conditioned responses, inculcated by a system of rewards and punishments, drawing their support from the instinct for self-preservation. It is of interest to compare the results with those Pavlov (1928) obtained in his original experiments on conditioned responses in dogs. As is well known, he was able to establish quite arbitrary associations between food and other stimuli, so that in time the other stimuli came to symbolize the food itself. Such associations could be broken down in a process of deconditioning by the interposition of other stimuli. Moreover, some dogs, when confronted with simultaneous conditioning and deconditioning stimuli, found themselves unable to resolve the conflict and retreated into what closely resembled a neurosis.

The force of the conditioning stimuli depended upon their relationship to food. Some psychologists have postulated a special nutritive instinct, but it is difficult to believe that the act of feeding, no matter how elaborately it is disguised, can be dissociated from the mere necessity for keeping alive. In other words, feeding is simply one of the most important manifestations of the self-preservative instinct, and the conditioned responses elicited by Pavlov derived their force from the urge to self-preservation, exactly like the quite arbitrary conditioned responses which characterize human behaviour in civilized communities. Similarly, humans can be deconditioned by appropriate treatment and turn to embrace completely contrary views on religion, social custom and so on. Further, some humans also retreat into neurosis when faced with a conflict which they lack the capacity to resolve.

Since it seems clear that an elaborate set of conditioned responses can be erected upon the self-preservative instinct, it is natural to enquire whether a corresponding set can similarly be built upon the only other instinct we can be sure about—the reproductive instinct. This possibility was explored some years ago (Abbie, 1941), but one could not at that time find any responses that were not clearly derived from the self-preservative series. Subsequent contemplation, however, has led to the view that various sexual aberrations (such as fetishism) which can serve as sexual substitutes, or at least the more or less elaborate rites that some couples find essential to consummation, might be looked upon as conditioned responses which derive their force from the sexual urge. At all events, this is a field of enquiry worthy of further exploration.

Summary.

1. The question of instinctive behaviour in animals, including man, is considered.
2. It is concluded that there are only two instincts: self-preservation and reproduction.
3. It is also concluded that no more than these two are necessary to explain all the activities of the human under the most complicated social conditions.
4. Communal behaviour does not depend upon any special herd instinct. It depends instead upon an elaborate system of conditioned responses which derive their force from the instinct for self-preservation.
5. It seems possible that a comparable set of conditioned responses can be derived from the reproductive instinct.

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Programme of the Seventh Pacific Science Congress

GILBERT ARCHEY*

THE briefest survey of the scientific problems of the Pacific reveals a range and complexity that require for their elucidation both technical coöperation between sciences and administrative coordination between countries. The Organizing Committee of the Seventh Pacific Science Congress, which is to meet in Auckland and Christchurch in February,† hopes that the programme that is being developed may promote both of these means

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† This JOURNAL, *10* (1948), 146 and 182.

of research. The Congress will, in considerable part, take the form of joint meetings of two or more divisions.

In Geology, contributors to the symposia on "Mountain Structure of the Pacific Basin" and on "Seismology in the Pacific" will include W. A. Atwood, Perry Byerly, R. Sonder, Beno Gutenberg, C. D. Richter and K. E. Bullen. Among contributors to the symposium on "Volcanology of the Pacific" will be Gerald A. Waring, Donald E. White, and J. Westerveld. Each symposium will be introduced by a report from the Chairmen of Standing Committees appointed by previous Congresses, namely H. A. Brouwer, E. A. Hodgson and P. Marshall.

A latitudinal division of the Meteorology programme into tropical, temperate and high latitude meteorology may prove to be more nominal than truly regional, for it is anticipated that the meteorological relations between these zones will be a dominant theme in the discussions. A symposium on research needs and techniques is expected to supplement and develop the application of the rapidly developing means of research discussed at a South-West Pacific conference of meteorologists held in New Zealand last April.

The Oceanography programme is already strong in respect of reviews of research and future programmes: these will also closely concern the marine biology and fisheries interests in the Zoology division. Such reviews, as well as general studies on, for example, eustatism and marine sedimentation, are being contributed by workers in leading oceanographical research stations in Canada, United States, Indonesia and the Philippines and by scientists of the occupation forces in Japan.

In Zoology over fifty papers have been notified. They promise a thorough presentation of the research and administrative problems inherent in biological control, economic entomology and nature conservation. In the symposia on terrestrial faunas of the Pacific, discussion on isolation, mutants, speciation and migration will be prominent. Botany, Agriculture and Oceanography will join with Zoology in the symposium on Protection of Nature and Conservation. The Botany division will give attention chiefly to problems of plant geography in the Pacific and to the distributional and ecological aspects of the study of marine algae, particularly in respect to the already wide and continually expanding range of their economic and industrial utilization.

Basic agricultural requirements of "Soil Survey and Classification" and "Methods of Land Classification and Utilization" are the subjects of the first two symposia of the division of Agriculture; Dr. R. L. Pendleton and Dr. J. W. Coulter are contributing the respective Standing Committee Reports. "Methods of Improvement in Dairy Cattle" will be considered not only as related to present pastoral countries but also in respect to breeds suited to tropical regions. Although the symposium on "Improvement of Food and Forest Crops in the Pacific" will deal chiefly with technical agricultural aspects of the subject, it will have a bearing also upon the important symposium on "Changing Agricultural Economy in the Pacific Islands" which is being organized for Anthropology and which is to be discussed with the divisions of Public Health and Social Sciences.

Applied Anthropology will have a related field of enquiry in the symposium on "Administration and Welfare" including contemporary culture change among Pacific dependent peoples. Culture change will be considered separately, though in its more basic anthropological aspects, in the symposium on "Anthropological Studies in Micronesia", which will include reports from members of the United States' Pacific Science Board teams which have recently spent periods of about six months in the different groups of the area.

Public Health, too, will receive contributions from this area and from Polynesia, comprising filariasis studies by U.S. Navy Medical officers. New Zealand workers will be offering papers on Nutrition and Dental Caries among dependent peoples. Pathological, clinical and administrative aspects of tropical health problems are contained in a group of papers from the Philippines. In this division the teaching of tropical medicine generally and the training and use of native medical practitioners are to be discussed.

The social aspects of many of the problems to be brought to Congress discussion will be the special concern of the Social Sciences division. Apart from its own particular subjects, e.g., demographic problems, education among dependent peoples, and the problem of peoples of mixed blood, chief interest may lie in the symposium on the Social Implications of Science. Atomic energy, which proclaims the urgency of the subject, is by no means the only important aspect of it, for each science has its own responsibilities to society and its own opportunity for conferring practical benefits on man as well as for influencing his social and intellectual advancement.

Teaching and Research in the Universities*

I. Reply from Melbourne.

Professor Burnet's article on this subject raises many interesting problems, the solution of which would greatly assist the progress and dissemination of knowledge. While recognizing Professor Burnet's evident desire to assist the universities, we believe that the

* This Journal, *11* (1948), 5; a letter from Professor F. M. Burnet, F.R.S. A *Reply from Hobart* was published in This Journal, *11* (1948), 61.

segregation of the functions of teaching and research that he advocates would stultify both these functions: nor can we accept many of the statements and arguments used in support of the suggestion.

The educational methods of a university depend mainly upon personal relationships between honest scholars—staff and students—rather than upon doctrinaire methods of teaching. They are unlikely to be successful if conducted by a staff composed of some who teach from a background of reading and *observation* of research and others who lecture only in their narrow specialist fields. University education should aim at provocative teaching by persons who are themselves participating in the development of their subject. Even the present level of segregation of brilliant research workers from contact with students must impoverish the future of science. Some guidance in teaching methods would be useful for many lecturers, but successful teachers are more likely to be found among researchers than in the ranks of technically trained administrators.

That the part-time research carried out by teachers could be worthwhile from the purely research aspect Professor Burnet denies, merely, it would seem, "because it *is* part-time". Surely, however, it is true that modern science is largely the product of part-time research? Most scientists, in fact even those who may be classed as full-time research workers, must have responsibilities in addition to pure research. Furthermore, it is obvious that the part-time research of one man may be of much greater significance than the full-time research of another. That the more able man might contribute more to direct scientific advances by full-time than by part-time work is possible. But we believe that teaching and research must be complementary in a university, and that a "professor" who specialized in teaching alone would soon cease to function as a professor should. A scientist endowed with such intellectual powers as would enable him to preside over meetings of research workers at the level of effective discussion and criticism would certainly not be content to spend his days in teaching and in studying teaching methods. Let us agree with Professor Burnet that such fundamental investigations into paedagogical problems lie mainly within the sphere of departments of education and psychology: but in these departments the physicist, chemist, and biologist should tread with proper humility.

Let us agree, too, that the university system "does not work out quite so badly as it ought to". A university is a community, with its own traditions, ideals, laws and social customs. Its function is to learn and teach the known and to explore the unknown. Its material support is from outside, but its moving spirit must be and is from within. Its members of staff are drawn from the top ranges of intelligence in the community, but their literacy, articulateness, curiosity and personality are not neglected in making appointments. A university is fortunate indeed if all the appointees have one or two of these attributes at a high level and the remainder of such quality and intensity that those appointed are well adjusted in the learned society which a university should be. Suitable appointees will show a great diversity of personality—the organization must be malleable to them unless we are to break them to it. Against the rigidity of Professor Burnet's suggested structure even the human characteristics that make the present system workable would almost certainly fail.

In writing his article Professor Burnet was undoubtedly prompted by the feeling, which the undersigned share, that neither the teaching nor the research-output of the Australian universities reaches a uniformly high level under present conditions. With the current staff-student ratios it is clearly impossible for many full-time members of university departments to function other than as teachers. To force them further into this category and to provide by contrast full-time research units as proposed by Professor Burnet would lead to complete stagnation in the minds of many who, granted a reasonable degree of leisure, could substantially contribute to the discovery of new knowledge. The need is particularly urgent for a better appreciation by the several governments of the problems confronting the State universities, in the expectation that this must lead to a more enlightened and liberal endowment of university function. In the United Kingdom financial assistance by the Government is currently thrice that of the pre-war level and it will be of six-fold intensity by 1951-52. While it is true that money alone will not provide the complete solution of the difficulties facing the Australian universities, there is no doubt that funds are still inadequate and do not permit of desirable future development.

E. J. Hartung, S. Sunderland,
E. Heymann, O. W. Tiegs,
E. S. Hills, V. M. Trikojus,
P. MacCallum, J. S. Turner,
L. H. Martin. S. M. Wadham,
R. Douglas Wright.

University of Melbourne,
8 October, 1948.

II. Reply from Sydney.

The relation between teaching and research in universities is an old problem—in a way, an insoluble problem. The ideal university professor should be an inspiring personality, a master of his subject, a first-rate investigator, a skilled organizer and administrator and a good teacher. Such properties are rarely, if ever, found together in a single person. Vocational training on the one hand, the maintenance of the tradition of learning and active contribution to the development of knowledge on the other hand, require a dif-

ferent emphasis: the former rather on educational and organizatory abilities, the latter on depth of knowledge, imagination, and experimental skill.

Professor Burnet, having as his main subject the university education of medical students, and being "concerned with attempts to remedy the present difficulties of Australian universities", overemphasizes vocational training to such a degree that he sometimes appears to forget the need for original scholarship. In my opinion, vocational training is already greatly overemphasized in Australian universities, to the detriment of learning and contribution to knowledge. University research in England and elsewhere is still leading, in spite of the fact that it is "part time": it is certainly not "of relatively unimportant character".

I agree with Professor Burnet that there is need for improvement of methods of teaching and demonstration, but the possibilities of technical improvements in mass teaching must not be overestimated. Establishment of the right proportion between the number of students and of teaching staff is the only way in which a solution of this problem can be found. In the U.S.A. there is one teacher to every three or four students! (*Brit. Med. J.*, 2, 1948, 473.)

The ability of a man to become a successful university teacher is not easily gauged. The selection according to research achievement, condemned by Professor Burnet, assures at least mastery of the field, imagination and experimental skill; Professor Burnet will probably also admit that the leadership of a successful research team today requires a certain talent for organization. Experience in teaching and knowledge in the organization of a university department can be given to the young research workers by appointing them as demonstrators and allowing them to lecture in their special fields to advanced students. The allotment of such duties will also tend to prevent overspecialization, a danger to research which is not connected with teaching; this Professor McAulay has already pointed out. Elementary teaching and administrative functions can be far more readily delegated than the inspiration which comes from close contact with the rapidly progressing field of one's subject by active research. There is no need for the man directing research to spend much of his time in "handling test tubes and chicken embryos"—although the warning words of Sir Joseph Barcroft should not be forgotten, that a teacher ceasing to work himself on the bench and finding only time to organize his students' research, should look out for the writing on the wall (*Respiratory Function of the Blood*, Vol. 2).

Professor Burnet admits that the present scheme of selection by research ability (is it really the scheme of selection in Australia?) "does not work out as badly as it ought to do". I am convinced that his own scheme would work out far less satisfactorily than he imagines. I doubt whether his ideal professor, who after spending two to three years in research up to his Ph.D. degree had no other contact with research than participation in Saturday morning discussions, will still remain master of his field. The "clogging of the works" by old age (over 40?) is far more likely to endanger him than the professor active in research. Nor can I believe that there will be no ill-feeling between an able research leader, with important contributions to science to his credit, and the teaching head of the department. The duplication of chairs would be as costly as the increase of the teaching staff and in practice may not work out smoothly.

In the sciences, purely vocational training ought to become the function of the "Technical Universities" with consequent diminution of the number of students at the universities. In medicine, where such a separation may not be desirable, the appointment of a larger staff would decrease the burden of teaching and administration on the head of the department.

Great teachers and research scholars, such as Sir Frederick Gowland Hopkins, delegated much of the elementary teaching and administration to other members of their staff. Only in this way can a "school" be created, in which the professor and his senior workers remain in close personal contact in research and in intimate lectures. Some great scientists, in spite of directing fundamental research, have been born teachers, taking pride in their elementary classes, while others—Helmholtz is a well-known example—have been notoriously bad teachers for junior students, but an inspiration to senior ones. The solution is not to exclude scientists of Helmholtz's type from university chairs, but to supplement them with associate professors who take over education and administration. There is no reason why the professor should regularly mark individual examination papers, read from his or others' textbooks in lectures, or carry out administration unaided. Much of the administration can be handled by an administrative assistant, an arrangement common in European university departments and evidently now being followed by Canberra University. The administrative assistant can be chosen from the ranks of graduates who later intend to go into industries or the C.S.I.R.; he will thus also benefit by the experience gained in his position. That part of the teaching concerned with factual material should be largely delegated to readers, lecturers and demonstrators.

There remains the problem of a closer correlation of extramural research with the universities. On the European continent this has been solved by the universities conferring honorary professorships to outstanding research scholars in the industries or research institutes. Such an arrangement conveys benefits to the universities and to the scholars. The English system, "one subject, one profes-

sorial title", has already been modified to some degree, and such modification, if used in moderation, need not lead to the devaluation of the professorial title.

R. LEMBERG.

Institute of Medical Research,
Royal North Shore Hospital,
Sydney.
6 November, 1948.

III. REPLY FROM ADELAIDE.

I should like to say that I heartily endorse the remarks made by Professor McAulay (This JOURNAL, *11*, 61) when commenting on the statements made by Dr. F. M. Burnet. Students taught according to the methods outlined by Professor McAulay would be infinitely superior, with regard to initiative and original thinking, to the automatons produced by the method he criticizes. One further observation that may be added, with regard to the teaching of science in Australia, is that the student devotes too much time to practical work and is given too little encouragement in referring to the original literature. These remarks apply principally to the final years of a Science course, when approximately half a student's time should be free to devote either to reading or cultivating outside interests.

A lecturer must necessarily be engaged in research work, as otherwise the temptation is too great to shelve newly arrived journals, with the result that lectures are "cribbed" from standard textbooks which, we all know, contain only too many errors. Furthermore, a student's interest is often aroused when he knows that the lecturer is personally engaged upon a certain topic.

We must be careful that the Science Faculties in our universities do not assume the status of technical institutes as these two necessary bodies should be entirely different in their outlook. It should not be the university's aim to supply a machine capable of industrial routine but rather an individual equipped with a clear and critical mind, understanding a little but anxious to assimilate more.

KENNETH H. PAUSACKER.

Department of Chemistry,
University of Adelaide.
8 November, 1948.

IV. ONE TERM'S LEAVE.

(Abstracted from the Melbourne *University Gazette*, *4*, 22 October 1948, 81.

The middle term of 1948 I spent on leave and came back confirmed in a view which I held before: that every university lecturer engaged in a full-time teaching programme needs one term off every two years, in addition to sabbatical leave. If this sounds greedy, it is merely because we have become conditioned to accepting hack work as our normal occupation.

When the poet Gray was Regius Professor of Modern History in Cambridge, there occurred a most deplorable outbreak of criticism of University professors. It was even suggested that they should sometimes lecture. Gray's opinion was asked and it was put to him that fifty lectures a year would be a fair stint. He considered the matter and gave his opinion. Yes, professors should lecture; but fifty was too many. Perhaps three would be a reasonable number. The clamour died down and the matter was forgotten; but Gray's conscience was pricked, though he had been appointed to a recognized sinecure. He set to work to write an inaugural lecture. He divided his subject into headings, and under each heading he filled innumerable notebooks. But his life was darkened by this unwonted burden, and after four years of great labour he died, his lecture unfinished and never delivered.

We toss off our stint of so many lectures a week, and attend meetings innumerable—and Gray was not cursed by the telephone. We administer large departments or lecture to large classes, and in our spare time serve as fathers-confessor to our students and try to do our duty as parents and citizens. The Long Vacation, which might provide relief, has been eaten away at both ends by examinations and by coping with large numbers of students. Few of us would exchange our jobs for others but this does not affect the fact that we cannot in present conditions do our jobs as well as we might hope. For our teaching, we live—of necessity and far too much—on our capital; and some of us are conscious how far that capital falls short of our need, and how much of it is in coin no longer current. We are at the further extreme from Gray's extreme; and somewhere between there lies a desirable mean.

All of us recognize that our teaching suffers unless finding out new things and gaining new understanding keeps pace with our expounding. All of us are required by our contracts to engage in research; and we all know how little we are able to honour this contract. The danger of it is that administration is so easy, if not to do well, at least to do first. The jobs keep coming at one, with the answer —letter, memorandum, comment or decision— urgently required before next Monday for one of the innumerable Board, Faculty or Committee meetings. So the days and terms and years slip by, and one reaches that strange reversal of all university values, that conscience is quiet when the administration is up-to-date and the classes held, and that conscience is uneasy if there is an hour of leisure "within working hours" to read an article bearing on one's chosen field of study.

I went to Perth for my term's leave genuinely frightened—for I had had no time free of administration of *some* sort since I came down from Oxford eighteen years ago— that I would simply be unable at this late stage to sit down every day of the week during two months to write a book. The pleasure of discovering that that quite reasonable fear was mistaken was my greatest stimulus to a term's solid work.

I was away from Melbourne for thirteen weeks. One of those weeks was spent on the train and four on a journey to Camden Harbour in the Kimberleys. In the remaining eight weeks I was able—emulating Trollope with increasing breathlessness—to write 45,000 words of what will be a book of about 70,000 words, on which I had been working in stolen moments for nearly three years.

This does point to the value of a single term's leave, not as a substitute for sabbatical leave, but as something of a bite between meals. Such a short time might be better used in the writing of papers than of books, for the amount I attempted required the sacrifice of rest in favour of the satisfaction of getting some work done. But whether it was used for a book or a paper, a term's leave once in two years would enable our overworked staff—and particularly our senior staff who carry the burden of administration—to add much more than they now do to the sum of knowledge. This term's leave of mine has cost the University very little. On a balance of accounts, I do not believe it has cost my students anything; for I at least can tell how much better my teaching is for the break. I believe that the teaching and research of the University would gain enormously if some such practice were normal.

I chose to spend the term in Perth for a number of reasons—climate, remoteness from our own telephones and committees, handiness nevertheless to librarians and to colleagues with whom I could discuss my work.

The choice of Perth was completely justified on all grounds. The University and St. George's College co-operated in arranging the most favourable conditions for my work. Of course, such pleasant conditions cannot always be provided; but the use of a room—or rather, in these days, of a corner of a room—in the University, and membership of a guild or union, are quite good substitutes; and the use of library or laboratory and of some secretarial help should be generally possible to provide. We need more movement backwards and forwards between our universities; provision like that made for me by both University and College in Perth would encourage such movement.

As some return, I gave two short courses of lectures in the School of History and shared in the work of a seminar held for final year honour students and graduates. It proved very refreshing to me—even for my main work of writing—to give those lectures to students not already familiar with my ideas. Their value to the students was probably of the same order, that they were lectures given by a visitor and that custom had not dulled their edge. All of us who teach in universities know that the smallness of our number reduces the chance of stimulating a friction of diverse ideas, and that both we and our students lose.

At intervals in my writing, I spent some time in tracking down descendants of the Victorian settlers who took sheep to Camden Harbour in the Kimberleys in 1864, and discussed the reasons for the failure of that settlement with a number of scientists and sheepmen. I spent a week exploring the sites of the attempted settlement, collecting grasses and plants, discovering one major error in the most recent maps and filming the country. I should like to organize a combined expedition during a May vacation to this part of the country. For my own work, I need a geologist, a soil chemist, a geographer and a botanist: with the addition of an anthropologist and a zoologist, and equipment for recording the native language and the marvellously interesting music of the corroborees, and for filming the corroborees at night time, we could cover most points of interest in a selected and limited area.

But that is by the way. I have been back here three weeks now, and my Kimberley papers remain in large part unpacked. It is the sharp experience of the contrast between even a term's opportunity and our normal scurry that has inspired this account. What has gone before this concluding sentence is some opinions and some data to throw into our discussion of "the research problem".

R. M. CRAWFORD.

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The subject of the Balance of Teaching and Research was discussed at one session of the sixth Congress of the Universities of the Commonwealth, which was held in Oxford, 19-23 July, 1948. Professor G. A. Currie of Western Australia, who opened the discussion, mentioned Ortega Y. Gasset's contention that the inquiring mind has been disastrous; that the constant, restless wish to discover has led the universities from the cultural centre of the community. Speakers suggested that much current research is of little value to its originating worker or to the recipient student and that the urge to publish its results is harmful. It was pointed out that sabbatical years are not in themselves the solution of the teacher's research problem: that to be able to do research currently with teaching he needs a timetable which allows him two or three days in each week without interruption. *Nature*, **162**, 1948, 441.

Genetics and Algal Life Histories

KATHLEEN M. DREW*

(Abstract of an article published in *Nature*, *161*, 14 February 1948, 223.)

In reply to Professor Barber's letter to This JOURNAL (1947) upon "Genetics and Algal Life Cycles", it is considered that an examination of the cytological evidence available for *Spermothamnion Turneri* and *Plumaria elegans*

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suggests that certain broad concepts applicable to the angiosperms cannot be transferred to the algae without modification. In those Floridae which have the *Polysiphonia*-type of life history, for example, the separation of the haploid and diploid phases of the sexual cycle into two physiologically separate entities (omitting any consideration of the cystocarp for the time being) contrasts sharply with the angiosperms, where the haploid is considerably reduced, enclosed in and physiologically dependent on the diploid. This somatically separate existence of the two phases means that:

(1) The "progeny" of the diploid phase is the haploid phase and *vice versa*. Some of the implications of this are referred to by the writer.

(2) While the sex organs are usually restricted to the gametophyte and tetrasporangia to the sporophyte, cases are recorded where, with varying degrees of frequency, both sex organs and sporangia occur on the same individuals. Whether these individuals are haploid or diploid is unknown except in *S. Turneri*, where the diploid plants bear both functional diploid sex organs as well as sporangia in which meiosis occurs, and *Nitophyllum punctatum*, where sporangia occur on the haploid gametophyte but undergo no reduction division. In such cases the gametophyte-sporophyte cycle is either in the process of being established or is upset.

(3) As a result of the occurrence of sex organs on the diploid, the formation of triploids and tetraploids becomes possible. This involves *no* abnormality in the formation of the gametes and is therefore comparable to the diploid × tetraploid cross in the higher plants.

Facts support the view that the production of triploid (90) individuals of *S. Turneri* are not rare. If, therefore, there is a 45⇌90 cycle (for which the evidence is incomplete) and such a cycle becomes genetically isolated, several genetical strains probably exist. Too little is known of the relationship of the normal sexual cycle and the triploid of *Plumaria elegans* to draw any conclusions and a comparison of the vegetative propagation of triploid angiosperms with the reproduction of this triploid by parasporangia is no more than a broad biological analogy. The parasporangium appears to be the morphogenetic expression of the triploid condition.

It is suggested that polyploidy, involving specific differences like those occurring in *Chrysanthemum* and *Solanum* may occur in the Florideae and evidence is given in favour of the formation of autopolyploids by the doubling of the chromosome number in the vegetative nuclei.

Terminology previously suggested (Drew, 1944) is restated briefly and to it is added the concept that a life history may include two or even three sexual cycles (cycles of two alternating nuclear phases), e.g. *S. Turneri*, possibly linked or independent. In conclusion a plea is put forward for an extension of experimental work leading to the analysis of the non-genetic as well as the genetic factors, both of which condition the life histories of the algae.

References.

Barber, H. N. (1947): This Journal, *9*, 217.

Drew, K. M. (1944): *Biol Rev.*, *19*, 105.

Recent Research

ECOLOGY

An ecological study of the New South Wales coast by W. J. Dakin, Isobel Bennett and Elizabeth Pope, "A Study of Certain Aspects of the Ecology of the Intertidal Zone of the New South Wales Coast" (*Aust. Jour. Sc. Research*, *1*, No. 2, 1948) will be welcomed by all ecologists, biologists, and naturalists interested in the life occurring on the coast. The authors planned their investigation to determine whether the considerable difference in latitude between the northern and southern boundaries of the State was reflected on the shores in the distribution of basic types of organisms. The physiography of the rocky coast at various localities is described, and notes on the major rock platforms are given. The chief zones, with reference to tide-level, the Littoral, Sublittoral, Supralittoral, Littoral-sublittoral, are described and named for the principal animal or plant normally growing in them, e.g., the Kelp Zone, the Pyura Zone (*Pyura praeputialis* Hiller), etc. It was found that very little geographical change occurs in the basic zonation of the rocky ocean shore between the Queensland and Victorian boundaries, but there are some striking changes in the range of the common members of the basic associations. Lists of common animal species in the various zones are given and these will undoubtedly be of the very greatest value to collectors and other ecologists. In conclusion the authors state that the zonation of plant and animal associations are reminiscent of conditions found on the shores of other temperate lands such as South Africa and California, etc. The paper is illustrated by numerous plates of high quality. It is to be regretted, however, that a paper describing so much original work as the result of the co-operative efforts of the authors over a considerable period of time should have been written in a semi-popular style and that the *Australian Journal of Scientific Research* should have departed from the usual style expected in a scientific journal of some standing in publishing it in its present form.

PALAEOPEDOLOGY

The recognition and study of evidences of earlier climates on present-day land surfaces is particularly important in some, and perhaps all, parts of Australia. Two publications

describing the evidences of earlier soil-covered land surfaces which should be read carefully by geologists, geographers, and above all by the soil scientists for whom they were written have been published by the Council for Scientific and Industrial Research.

The first of these, "Post-Miocene Climatic and Geologic History and its Significance in Relation to the Genesis of the Major Soil Types of South Australia", by R. L. Crocker (*C.S.I.R. Bull.* 193, 1946) gives a most comprehensive and detailed study of the way in which post-Miocene climatic history, combined with the fundamental geology of South Australia, has given rise to polygenetic soils, the main factors being (1) the Pleistocene glaciations with recurrent exposure and drowning of the continental shelf, which gave the opportunities for extensive dune formation and aeolinites; (2) the recent arid period which caused the distribution of loessal material from travertine surfaces; (3) the continued solonizing influence of cyclic salt in areas of poor drainage; and (4) the moist and warm conditions of the Pliocene leading to extensive laterite formation. A diagram illustrates the linkages between certain of the major South Australian soil types. The geochemical aspects of such origins for the soils is stressed, and is clearly indicated in certain mineral deficient soils in the south-eastern portion of the State. Crocker has suggested the application of the same factors to southern Western Australian soils, thus challenging soil workers there to test his findings.

The second of these publications is "Pedogenesis following the Dissection of the Lateritic Regions in Southern Australia" by C. G. Stephens (*C.S.I.R. Bull.* 206, 1946). The origin of a laterite capping is still somewhat of a controversial point between geologists and soil scientists, but its physiographic significance, first recognized by Woolnough in 1918 in Western Australia, has never been seriously doubted. Climatic conditions, presumably in the Pliocene, were such that the formation of laterite took place over very extensive areas of Australia. Much of the original Pliocene(?) land surface with its soil covering (the laterite profile) is preserved intact in Western Australia because this part of the continent has been relatively stable and consequently little dissected. Some breaking down of the original profiles has, and is, occurring, and Stephens's paper ably summarizes the position. By the use of his diagrammatic representation of the relationship of soils formed as a result of the dissection of lateritic profiles the field interpretation of soil types derived during Recent and present climatic conditions from laterite is greatly facilitated. It is shown that all parts of a dissected laterite profile can act as parent materials of new soils, their original material having thus a most important bearing on their fertility. Stephens has made a most valuable contribution to the way in which geological knowledge can assist in interpreting soil origins in areas where laterite occurs, and, naturally, the same careful observation can be applied to soils in other areas. Further publications by the Soils Division along these lines, which assist so greatly in a geochemical understanding of Australian soils, will be awaited with interest.

TAXONOMY

Three important botanical systematic papers have appeared recently giving revisions of the genera *Swainsona* and *Brachycome*, and of the South Australian species of *Eucalyptus* respectively. Their publication focuses attention on the necessity for re-examniation of the Australian flora from time to time as the distribution becomes more widely known and new species are collected. Both the *Swainsona* and *Brachycome* papers actually constitute monographs on the respective genera giving as they do a most thorough and comprehensive account of the vegetative, floral, and fruit diagnostic characters together with descriptions of all the known species, subspecies, and varieties.

In "The Genus Swainsona" by Alma T. Lee (Contrib. N.S.W. Nat. Herbarium, Vol. 1, No. 4, 1948) the diagnostic characters are described in detail, and a key to the groups is provided in addition to an artificial key for practical identification. The chief economic importance of *Swainsona* concerns the toxicity of certain species to stock, and this revision arose from the difficulty of identifying species sent in for examination. Material from all the Australian Herbaria was examined. *Swainsona* occurs mainly in the inland low-rainfall areas and it is absent from the endemic flora of south-western Australia. The paper is illustrated by distribution maps and drawings showing features of diagnostic importance.

"A Revision of the Genus *Brachycome* Cass. Part 1, Australian Species" by Gwenda L. Davis (*Proc. Linn. Soc. N.S.W.*, 73, Parts 3-4, 1948) is similar in scope to the previous paper, but differs slightly in treatment. Two sub-genera occur, *Eubrachycome* and *Metabrachycome*, based on the character of the anther, and each contains a number of superspecies or groups of species. A number of new species are described, and the author has very thoroughly traced the whereabouts of original specimens in various Herbaria, some being located as far afield as Paris and Geneva. The genus has an Australia-wide distribution mainly in the eastern and southern States. A comprehensive key is given, based on the characters of the fruit, flower and vegetative habit. The paper is illustrated by line drawings of fruit and habit so that identification of species should be rapid. The distribution and affinities of species is discussed.

The third of these papers is "Key to the South Australian Species of *Eucalyptus* L'Herit" by Nancy T. Burbidge (*Trans. Royal Soc. Sth. Aust.*, 71, Part 2, 1947). The author states that it is not intended as a

complete revision of the local species, as insufficient is known of the distribution. The key to the species is based on the character of the fruits which are illustrated by very plain, clear line drawings. Short descriptions of the forty-nine South Australian species are given. This is a most useful paper on the genus *Eucalyptus* which "includes an unusually high percentage of variable and unstable species which . . . can be called polymorphic".

News

The Edgeworth David Medal

The Edgeworth David Medal of the Royal Society of New South Wales is to be awarded annually for research published by a scientist under the age of thirty-five years.

The award is for a distinguished contribution of work done mainly in Australia or its Territories or adjacent Seas, or contributing to the advancement of Australian science. The fields of award will be changed in annual rotation, according to the following Groups:

A. Mathematics, Physics, Chemistry, Biochemistry, Astronomy, Meteorology, Engineering, and related Sciences.

B. Geology, Botany, Zoology, Physiology, and related Sciences.

C. Psychology, Anthropology, Sociology, Economics, Geography and related Sciences.

The first award is to be for the year 1948. It will be made for work in the subjects of Group A, published before 1 January, 1949. The recipient must not have reached the age of thirty-five years before 1 January, 1949. Nominations have been invited from the Australian National Research Council, from Royal Societies and universities in Australia, and from other scientific bodies in Australia. They should submit details of the nominee's work and should reach the Royal Society of New South Wales not later than 28 February, 1949.

Australian Journal of Scientific Research

The *Australian Journal of Scientific Research* is at present being issued quarterly in two series—Series "A" covering the Physical Sciences and Series "B" the Biological Sciences. Nos. 1 and 2 of the first volume of both series have been issued and the third number is expected from the printers shortly.

Control of the Journal is in the hands of an Editorial Board consisting of Professors W. J. Dakin, E. J. Hartung, L. H. Martin and J. G. Wood, with the Editor, Dr. N. S. Noble, as Chairman. Suitable papers will be accepted from research workers regardless of the employing organization or the country of origin. To ensure the maintenance of the quality of contributions, a strict refereeing system has been adopted.

The subscription to the new Journal is £1 10s. per annum for each series. All enquiries and manuscripts should be forwarded to the Editor, *Australian Journal of Scientific Research*, Council for Scientific and Industrial Research, 314 Albert Street, East Melbourne, C.2, Victoria.

A.N.Z.A.A.S.—Hobart Meeting

Well over a thousand members will be attending the Hobart Congress in January. The problem of finding accommodation is on a population basis equivalent to placing over sixteen thousand visitors in Sydney and is accentuated by coincidence with the peak of the Tasmanian tourist season. Registrations at the beginning of December were: N.S.W., 260; Victoria, 306; Tasmania, 291; Queensland, 29; South Australia, 149; Western Australia, 67; New Zealand, 18; A.C.T., 56; Overseas, 6; total, 1182. The Honorary Accommodation Secretary, Mrs. A. D. Foot, has managed to place all-comers.

For the information of members still wishing to register for excursions, it is announced that no vacancies now remain in Excursions Nos. 1–6, 8, 12, 14–16, 32, 40.

Munitions Supply Laboratories—Change of Name

The name of the M.S.L. has been changed to DEFENCE RESEARCH LABORATORIES.

This change of name has been made to emphasize the *raison d'être* of the establishment, which is to make laboratory investigations aimed at the development of new weapons and of methods of manufacturing military equipment, whether of new or conventional types.

Because the development of secondary industries increases the defence potential of the nation, D.R.L. will continue, as it has done since the war, to provide technical service to private industry.

Chair of Agricultural Economics

The Senate of the University of Sydney has accepted grants offered by the Commonwealth Bank from its Rural Credits Development Fund, for the establishment of a Chair of Agricultural Economics—an initial grant of £40,000 to establish the chair, and additional grants of £2,000 a year for five years for maintenance. The grants are subject to the conditions that the first purpose of the chair shall be to enable original research to be undertaken in the field of Agricultural Economics, and that the results of such research shall be disseminated as widely as possible and made available for the benefit of all primary producing interests in Australia.

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

December, 1948

EDITOR: N. H. WHITE, Faculty of Agriculture, Sydney University, Sydney.

All communications concerning abstracts should be addressed to the Editor.

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AGRICULTURE.
(Continued.)

14717. **Best, R. J.** Longevity of Tobacco Mosaic Virus. Part 1. *In Vitro* Life of the Pure Virus in Buffer Solution at pH 4. *Ibid.*, xxvi (2), 1948, 163–169.—A sample of pure tobacco mosaic virus prepared from infective juice in 1935 by precipitation at its isoelectric point, and suspended in buffer solution at pH 4, was tested for infectivity over a period of 12 years. The sample of virus maintained its infectivity unchanged during this period.

14718. **Butler, F. C.** Take-all of Wheat. *Agric. Gaz. N.S.W.*, lix (5), 1948, 248–250.—Symptoms are described and conditions favouring the disease discussed.

14719. **Hutton, E. M., Mills, M., and Giles, J. E.** Fusarium Wilt of Tomato in Australia. 2. Inheritance of Field Immunity to Fusarium Wilt in the Tomato (*Lycopersicon esculentum*). *J. Coun. Sci. Ind. Res.*, xx (4), 1947, 468–474.—The variety Pan America was found to be a suitable parent for introducing field immunity to Fusarium wilt into new tomato hybrids suited to Australian conditions. Simple crosses have resulted in the incorporation of field immunity in suitable hybrids, but multiple crosses containing Pan America in two places are preferred. The inheritance mechanism for field immunity appears to be influenced by both the female and the pollen parent used.

14720. **Hutton, K. E.** Brown Rot of Stone Fruit. *Agric. Gaz. N.S.W.*, lviii (9), 1947, 487–491.—Description of the disease, with control measures.

14721. **Magee, C. J.** Root Diseases of the Banana. *Ibid.*, lxiii (8), 1947, 419–422.—Brief descriptive notes on Panama disease (***Fusarium oxysporum cubense***), Rhizoctonia root rot (***Rhizoctonia solani***), root knot (***Heterodera marioni***) and corm rot (*Clitocybe* sp., and *Armillaria mellea*).

14722. **Magee, C. J.** Woodiness or Mosaic Disease of Passion Fruit. *Ibid.*, lix (4), 1948, 199–202, 208.—A review of symptoms produced and recommended control measures.

14723. **Sutton, W. S.** Early Blight of Tomatoes. *Ibid.*, lix (6), 1948, 29–300.—A brief popular description of the disease and recommended ontrol measures.

ENTOMOLOGY.
Hon. Abstractor: A. Musgrave.

14724. **Allman, S. L., and Wright, J. A.** Grasshopper Control. Recent Developments. *Agric. Gaz. N.S.W.*, lix (5), May, 1948, 233–236, illustr.—The use of poison bran baits is described and the spraying and dusting of grasshopper swarms by means of aircraft.

14725. **Allman, S. L., and Wright, J. A.** Grasshopper Control. Some Recent Developments. *Agric. Gaz. N.S.W.*, lix (6), June, 1948, 283–288, illustr.—In this part of their paper the authors describe such recent developments as insecticidal fog applications and the use of new type dusts by ground dispersal.

14726. **Allman, S. L., and Wright, J. A.** Grasshopper Control. Some Recent Developments. *Agric. Gaz. N.S.W.*, lix (7), July, 1948, 345–349, illustr.—Spraying for grasshopper control, and the new insecticides in dusts, sprays or aerosols.

14727. **Andrewartha, H. G., and Birch, L. C.** Measurement of "Environmental Resistance" in the Australian Plague Grasshopper. *Nature*, clxi (4090), March 20, 1948, 447–448.

14728. **Anon.** Entomological Investigations. *21st Ann. Rpt. C.S.I.R., for the Year Ended 30th June*, 1947 (1947), 19–25.—Results of investigations into insects and arachnids of economic importance and the control measures adopted.

14729. **Anon.** Animal Health and Production Investigations. *21st Ann. Rpt. C.S.I.R., for the Year Ended 30th June*, 1947 (1947), 25–33.—Refers to external parasites of sheep and the measures adopted for their control, and with the blow-fly strike problem.

14730. **Armstrong, J. W. T.** On Australian Coleoptera. Part i. *Proc. Linn. Soc. N.S.W.*, 1947, lxxii (5–6), Jan. 15, 1948, 292–298, 1 tf.—Lagriidæ: Key to Australian genera.

14731. **Bagnall, R. S.** Contributions Toward a Knowledge of the Tullbergiidæ (Collembola-Onychiuroidea). i-iii. *Ann. Mag. Nat. Hist.*, xiv (114), June, 1947 (March 2, 1948), 435–444.—*Dinaphorura* Bagnall, 1935, key to spp. *D. harrisoni* sp.n., N.S.W.: Patonga Bay, Woy Woy. *Australphorura* n.g. Orthotype, *A. wahlgreni* sp.n. N.S.W.:

Patonga Bay. *Protullbergia* n.g. Orthotype, *Tullbergia trisetosa* Schäff. key to spp. *P. salmoni* sp.n. N.S.W.: Patonga Bay (type and paratypes), Woy Woy and Lindfield (one only). *P. willemi* sp.n. N.S.W.: Woy Woy. *P. womersleyi* sp.n. N.S.W.: Lindfield.

14732. **Blair, K. G.** Some Alien Coleoptera Occasionally Found in Britain. *Ent. Mo. Mag.*, lxxxiv, June, 1948, 123–124, pl. D (col.).—Cleridæ: *Paratillus carus* Newman, an Australian species, figured.

14733. **Brooks, J. G.** Some North Queensland Coleoptera and Their Food Plants. *N. Q'land Nat.*, xv (87), June 1, 1948, 26–29.

14734. **Burns, A. N.** New Records of Lepidoptera from Victoria, with Notes on Some Rare Species. *Mem. Nat. Mus.*, Melbourne, No. 15, Oct., 1947 (=Aug., 1948), 103–108.—Satyridæ: *Ypthima arctous* Fab. extends range of species to eastern Gippsland. *Oreixenica latialis* W. and L. extends range to Victoria (Mt. Hotham). Lycænidæ: *Candalides cyprotus* Olliff, extends range to Victoria (Little Desert, near Kiata). *Neolucia sulpitius sulpitius* Miskin, extends range to Victoria (Wingan Inlet, eastern Gippsland). Hesperidæ: *Anisynta dominula drachmophora* Meyr., records the species from the Victorian Alps (Mt. Hotham area). Sphingidæ: *Chromus erotus* Cram., a species rare in Victoria, records it from Everton, in the north-east.

14735. **Burns, A. N.** New Geographical Races of Australian Butterflies, with a Description of the Female, Larva and Pupa of *Pseudalmenus chlorinda barringtonensis* Whs. *Mem. Nat. Mus.*, Melbourne, No. 15, Oct., 1947 (1948), 86–102, pls. 3–8, tfs. 1–5.—Satyridæ: *Xenica klugi mulesi* n.subsp. S.A.: Wardang Is. *X. klugi klugi* Guer., map of distr. S. Q'land, N.S.W., V., Wardang Is., S.A., S.W. Aust., Tasm. affinities discussed.

14736. **Cannon, R. C., and Hegarty, A.** An Outbreak of Grass Webworm in Atherton Tableland Pastures. *Qld. Agric. J.*, lxv (6), Dec., 1947, 402–405, pl. 146–147.—*Calamotropha leptogramella* Meyr. (Fam. Crambidæ).

14737. **Carne, P. B.** Experiments in the Use of D.D.T. Against the Pasture Cockchafer, *Aphodius howitti* Hope. *J.C.S.I.R.*, Melbourne, xxi (1), Feb., 1948, 1–6, pl. 1.

14738. **Clark, L. R.** An Ecological Study of the Australian Plague Locust (*Chortoicetes terminifera* Walk.) in the Bogan-Macquarie Outbreak Area, N.S.W. *Bull. C.S.I.R.*, No. 226, 1947, 1–71, pls. 1–3, tfs. 1–10.

14739. **Clark, L. R.** Ecological Observations on the Small Plague Grasshopper, *Austroicetes cruciata* (Sauss.), in the Trangie District, Central Western New South Wales. *Bull. C.S.I.R.*, Melbourne, No. 228, 1947, 1–26.

14740. **Common, I. F. B.** Control of Corn Ear Worm on Tomatoes. *Qld. Agric. J.*, lxvi (2), Feb., 1948, 102–104.—Corn Ear Worm, *Heliothis armigera* Hbn. Refers also to Tomato Mite, *Phyllocoptes lycopersici* Mass. Leaf-eating Looper, *Plusia argentifera* Gn. Tomato Jassid, *Empoasca terrareginae* Paoli. Potato Tuber Moth, *Gnorimoschema operculella* Zell.

14741. **Drake, C. J., and Salmon, J. T.** A Second *Xenophyes* from New Zealand (Homoptera: Peloridiidæ). *Domin. Mus. Rec. Entom.*, Wellington, N.Z., i (5), June, 1948, 63–67, 2 figs.—Describes two new spp. from New Zealand and lists genera and species of Peloridiidæ including Australian forms.

14742. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lviii (12), Dec., 1947, 634–638, illustr.—White Wax Scale, *Ceroplastes destructor*. Benzene hexachloride (B.H.C.) in grasshopper baits. Fish and yabbies killed with D.D.T. Control of meat or road ants, *Iridomyrmex rufoniger* with B.H.C.

14743. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lix (1), Jan., 1948, 43–46, illustr.—Red Scale, *Aonidiella aurantii*, control, parasites and predators. Springtails (Collembola) and benzene hexachloride. Removal of residues from spray tanks. Correction, *Iridomyrmex detectus* for *I. rufoniger*.

14744. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lix (2), Feb. 1, 1948, 88–91, 101, illustr.—Parasites of grasshoppers: *Lucostivora pachytyli*, attacks Australian plague locust. Also *Helicobia australis* and *Trichopsidea ostracea*. Flies which develop in dead grasshoppers, *Muscina stabulans*, *Sarcophaga depressa*. Egg parasite of the plague locust, *Scelio fulgidus*, Qld., N.S.W., V., S.A. An Oleander Butterfly, *Euploea corinna*, life history. The Orange-barred Grass Moth, *Eutane terminalis*, invading houses.

14745. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lix (3), March, 1948, 149–152, illustr.—The Powder-post Beetle, *Lyctus brunneus*. D.D.T. as a danger to fish.

14746. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lix (6), April, 1948, 203–205, illustr.—Cabbage Moths, *Plutella maculipennis*, Cabbage White Butterflies, *Pieris rapae*. The Black Thrips, *Heliothrips hæmorrhoidalis*.

14747. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lix (5), May, 1948, 257–262. illustr.—Insect pests of beans: the Bean Fly, *Agromyza phaseoli*. Red Spider, *Tetranychus urticæ*. Green Vegetable Bug, *Nezara viridula*. Aphids or Plant-lice, Aphis spp. *Thrips* (Thysanoptera). Bean Leaf-hopper or Jassid, *Empoasca* sp. The Bean-seed Weevil, *Bruchus obtectus*. Green Mirid Bug, *Megacoelum modestum*. Caterpillars. The Pseudo-Looper Moth, *Plusia* spp. The Tomato Moth, *Heliothis armigera*. The Bean Butterfly, *Zizeeria labradus*. The Bean Pod Borer, *Maruca testulalis*.

14748. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lix (1), June, 1948, 305–308, 313, illustr.—San Jose Scale, *Quadraspidiotus perniciosus*. The White Rose Scale, *Aulacaspis rosæ*. The Vegetable Weevil, *Listroderes obliquus*. Control measures are given.

14749. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lix (7), July, 1948, 369–374, 390, illustr.—Tree Borers. The Fig Longicorn Beetle, *Dihammus vastator*. The Elephant Beetle, *Orthorrhinus cylindrirostris*. The Fig Twig-borer, *Hylesinus fici*. The Augur Beetle, *Bostrychopsis jesuita*. The Pine Weevil, *Aesiotes leucurus*. Cypress Pine Buprestid Beetles, *Diadoxus erythrurus* and *D.*

scalaris. The Kurrajong Weevil, *Axionicus insignis*. The Fruit-tree Moth Borer, *Maroga unipunctata*. Control measures are given.

14750. **Evans, H. W.** Applied Biology in Tasmania. *Ann. Appl. Biol.*, London, xxxii (2), 1945, 179–180. *Ex Zool. Rec.*, lxxxii, 1945 (1948).

14751. **Evans, J. W.** Some New Eurymelids from Australia and New Guinea (Homoptera, Jassoidea). *Trans. R. Soc. S. Aust.*, lxxi (2), Dec., 1947, 225–227, tfs. A–H.—*Eurymeloides nigrobrunnea* n.sp. N.W. Aust.: Port George. *Ipoella davisi* n.sp. N.W. Aust. *Bakeriola tasmaniensis* n.sp. Tasm.: Risdon. *B. rubra* n.sp. Q.: Moolooka.

14752. **Evans, J. W.** Some New Ulopinæ (Homoptera, Jassidæ). *Ann. Mag. Nat. Hist.*, xiv (110), Feb. (Publ. 10 Dec., 1947), 140–150, tfs. 1–2.—*Austrolpa tasmaniensis* sp.n. Tasm.: Mt. Wellington, Hobart. *Notocephalius pallidus* sp.n. A.C.T.: Blundells. *N. montanus* Evans, 1942. Tasmania. Lists spp. of *Cephalelus* Percheron, and *Notocephalius* Jacobi.

14753. **Gentilli, D.** Bioclimatic Controls in Western Australia. *W. Aust. Nat.*, i (4), March, 1947, 81–84, 4 maps; *op. cit.*, i (5), June, 1947, 104–107, maps 5–12.

14754. **Gilbert, L.** Zoological Notes on the Northern Territory (June, 1944, to September, 1945). *Vict. Nat.*, lxv (4), August, 1948, 96–102.—Refers, *inter alia*, to insects and arachnids, including Red-back Spider, ticks, grass flea, etc.

14755 **Greaves, T.** The Control of Silverfish and the German Cockroach. *J. C.S.I.R.*, xx (4), Nov., 1947, 425–432, f. 3.—By means of 10 per cent. D.D.T. dust in Canberra houses and hostels using 1½–2 lb. (for silverfish) and 3–5 lb. for cockroaches.

14756. **Hely, P. C.** Fuller's Rose Weevil (*Pantomorus* (*Asynorhynchus*) *godmani* Crotch). *Agric. Gaz. N.S.W.*, lix (3), March, 1948, 144–148, illustr.—History of introduction, life-history, host plants, injury, economic importance, method of spread, effect of climate, control.

14757. **Hickman, V. V.** Tasmanian Araneæ of the Family Hahniidæ, with Notes on their Respiratory Systems. *Pap. Proc. R. Soc. Tasm.*, 1947 (1948), 21–35, tfs. 1–28.—*Hahnia astrolomæ* sp.n. T.: Domain, Hobart, Risdon, Punch Bowl, Launceston. *H. ampullaria* sp.n. Domain, Hobart. *Neoaviola wellingtoni* sp.n. Mt. Wellington. In moss. *Scotopsilus bicolor* Simon, allotype ♂, Risdon; collected also at Trevallyn, The Cascades, Fern Tree and elsewhere. Notes are also given on the respiratory systems of *Scotopsilus*, *Hahnia* and *Neoaviola*.

14758. **Jenkins, C. F. H.** Biological Control in Western Australia. *J. R. Soc. W.A.*, xxxii, 1945–46, 12 July, 1948, 1–17.

14759. **Kemp, H. K.** Codling Moth Control. Part ii. Report on Codling Moth Investigations in South Australia carried out in the Seasons 1945–46 and 1946–47. *J. Dept. Agric. S. Aust.*, li (4), Nov., 1947, 184–186; *op. cit.* (5), Dec., 1947, 229–236, 238.

14760. **Kerr, R. W.** The Effect of Starvation on the Susceptibility of Houseflies to Pyrethrum Sprays. *Aust. J. Sci. Res.*, (B), Melbourne, i (1), Feb., 1948, 76–92, tfs. 1–5.

14761. **Lee, D. J.** Australasian Ceratopogonidæ (Diptera, Nematocera). Part i. Relation to Disease, Biology, General Characters and Generic Classification of the Family, with a Note on the Genus *Ceratopogon*. *Proc. Linn. Soc. N.S.W.*, 1947, lxxii (5–6), 15 Jan., 1948, 313–331, 23 tfs.

14762. **Lee, D. J.** Australasian Ceratopogonidæ (Diptera, Nematocera). Part ii. The *Leptoconops* Group of Genera. *Proc. Linn. Soc. N.S.W.*, 1947, lxxii (5–6), 15 Jan., 1948, 332–338, pl. xxi, 13 tfs.—*Leptoconops* Skuse, 1889, subg. *Leptoconops*, key to Australasian spp. *L.* (*L.*) *stygius* Skuse, 1889, type loc. ♀, Woronora, near Sydney, N.S.W., also Fitzroy Falls. *L.* (*L.*) *woodhilli* sp.n. Adelaide River, N.T. *L.* (*L.*) *longicornis* Carter, 1921, W. Australia. *L.* (*L.*) *grandis* Carter, 1921. W. Australia. *Styloconops* Kieffer, 1921. Genotype, *S. albiventris* (de Meijere), a New Guinea species. *S. australiensis* n.sp. Pittwater, N.S.W., biting man.

14763. **Lee, D. J.** Australian Ceratopogonidæ (Diptera, Nematocera). Part iii. The *Bezzia* Group of Genera. *Proc. Linn. Soc. N.S.W.*, 1947, lxxii (5–6), 15 Jan., 1948, 339–344, pl. xxi, f. 5, 8 tfs.—*Bezzia* Kieffer, 1899, key to spp. *B. latipennis* (Skuse), type ♀, Berowra, N.S.W. *B. curticornis* Kieffer, 1917, type ♀, Botanic Gardens, Sydney, N.S.W. *B. australiensis* Kieffer, 1917, ♀, Botanic Gardens, Sydney, N.S.W. *B. tasmaniensis* n.sp. ♂. Burnie, Tasmania.

14764. **Lee, D. J.** Australasian Ceratopogonidæ (Diptera, Nematocera). Part iv. The *Stilobezzia* Group of Genera. *Proc. Linn. Soc. N.S.W.*, 1947, lxxii (5–6), 15 Jan., 1948, 345–356, pl. xxii, 23 tfs.—*Stilobezzia* Kieffer, 1911, key to spp. *S. pictipes* Kieffer, 1911, type loc. ♀, Parramatta, N.S.W., allotype ♂ here described from Northwood, N.S.W., also females from same locality. *S. tasmaniensis* n.sp. ♀ ♂. Burnie, Tas. *S. genitalis* n.sp. ♂. Strahan, Tas *S. fitzroyensis* n.sp. ♀, Fitzroy Falls, N.S.W. *Monohelea* Kieffer, 1917, key to spp. *M. tigrinus* (Skuse), holotype, ♀, Berowra, N.S.W. *M. tasmaniensis* n.sp., Cradle Vall., Tas. *M. brevipes* n.sp. ♂, Katanning, W.A. *Acanthohelea* Kieffer, 1917; *A. pruinosa* Kieffer, 1917, ♂, Sydney, N.S.W.

14765. **Lee, D. J.** Australasian Ceratopogonidæ (Diptera, Nematocera). Part v. The *Palpomyia* Group of Genera. *Proc. Linn. Soc. N.S.W.*, lxxiii (1–2), 15 May, 1948, 57–70, pl. v, 20 tfs.—*Palpomyia* Megerle, 1818, key to spp. *P. decima* n.sp., Geeveston, Tas. *P. subalpina* n.sp., Blundell's, A.C.T. *Heteromyia* Say, 1825; *H. tasmanica* n.sp., Eaglehawk Neck, Tas. *Clinohelea* Kieffer, 1917, key to spp. *C. tasmaniensis* n.sp., National Park (holotype), Geeveston, Tas. (paratype). *Xenohelea* Kieffer, 1917, key to spp. *X. tonnoiri* n.sp., Advent Bay (holotype), Geeveston, Tas. (paratype). *Johannsenomyia* Malloch, 1915; *J. australiensis* n.sp. Cotter River, A C.T. Types in C.S.I.R. Mus.

14766. **May, A. W. S.** Red Scale Control. *Q'land Agric. J.*, lxv (5), Nov., 1947, 311–314.—*Aonidiella aurantii* Mask.

14767. **Morison, D. L.** Beekeeping Hints. The Wax Moth and its Control. *Agric. Gaz. N.S.W.*, lix (7), July, 1948, 375–378, illustr.—Greater Wax Moth, *Galleria mellonella*; the Lesser Wax Moth, *Achroia grisella*.

14768. **Mungomery, R. W.** Report of the Division of Entomology and Pathology. *47th Ann. Rpt. Bur. Sugar Exp. Stat.*, Brisbane, 1947, 35–45.—Cane Pests: Beetles, *Dermolepida albohirtum* Waterh.; *Lepidiota frenchi* Blkb.; *L. consobrina* Gir.; *L. trichosterna* Lea; *Pseudoholophylla furfuracea* Burm.; *Lacon variabilis* Cand. Grasshoppers: *Gastrimargus musicus* Fab. *Locusta migratoria* L., *Oedaleus australis* Sauss., *Rhabdoscelus obscura* Boids. Caterpillars of *Micus frugalis* Fab. (predators), *Sphex clavus* Sm. and *Austromalaya souefi* Dist.). Termites: *Coptotermes acinaciformis* Frogg., *Mastotermes darwiniensis* Frogg., *Hamitermes obtusidens* Mjoberg, *Rhinotermes* (*Schedorhinotermes*) *intermedius seclusus* Hill.

14769. **Musgrave, A.** Some Butterflies of Australia and the Pacific. Family Danaidæ. Danaids i. *Aust. Mus. Mag.*, ix (8), July–Sept. (Sept. 30, 1948), 270–275, illustr.

14770. **McCulloch, R. N., and Waterhouse, D. F.** Laboratory and Field Tests of Mosquito Repellents. *Bull. C.S.I.R.*, No. 213 1947, 28 pp.

14771. **McKeown, K. C.** Australian Insects. xxxii. Coleoptera 9. The Colydiidæ. *Aust. Mus. Mag.*, ix (7), Jan.-June (June 14=July 7, 1948), 240–241, frontispiece (*ex* Carter and Zeck, *P.L.S. N.S.W.*, 1937).

14772. **McKeown, K. C.** Australian Cerambycidæ. viii. Notes on a Collection from the Western Australian Museum, with Descriptions of New Species. *Rec. Aust. Mus.*, xxii (1), June, 30 (=26 July, 1948), 49–63, tfs. 1–11.—New forms are as follows: *Phacodes singularis* sp.n. W.A.: Narrogin. *Tryphocaria northamensis* sp.n. W.A.: Northam. *Coptocercus sannio* sp.n. W.A.: Hopetown and Rottnest Is. *Didymocantha picta* sp.n. W.A.: Edjudina. *Bethelium inconspicuum* sp.n. W.A.: Salmon Gums. *Uracanthus regalis* sp.n. W.A.: Denmark. *U. multilineatus* sp.n. W.A.: Lake Violet. *U. fuscostriatus* sp.n. W.A.: Maylands. *U. dentiapicalis* sp.n. W.A.: Wandadgee Station. *Emenica fulva* sp.n. W.A.: Kukerin and Lake Wingham. *Ancita longicornis* sp.n. W.A.: Edjudina. *Disterna forrestensis* sp.n. W.A.: Forrest River district. *Platyomopsis canus* sp.n. W.A.: Cue, Mt. Jackson, Ankertell. *P. delicatula* sp.n. W.A.: Carnarvon. *Rhytiphora crucensis* sp.n. W.A.: Southern Cross, Borden. *R. argenteolateralis* sp.n. W.A.: Southern Cross. *Corrhenes glauerti* sp.n. W.A.: Bulong.

14773. **McKeown, K. C.** A Reference List of Types of Coleoptera in the Australian Museum. *Rec. Aust. Mus.*, xxii (1), June 30 (=26 July, 1948), 95–139.

14774. **McKeown, K. C.** Australian Insects. xxxiii. Coleoptera 10. The Trogositidæ. *Aust. Mus. Mag.*, ix (8), July-Sept. (Sept. 30, 1948), 267–269, illustr.

14775. **McKeown, K. C., and Mincham, V. H.** The Biology of an Australian Mantispid (*Mantispa vittata* Guerin). *Austr. Zool.*, xi (3), Feb. 11, 1948, 207–224, pls. xiv-xv, tfs. 1–13.—The authors here give the hitherto undescribed life-history, habits and behaviour of a member of the Mantispidæ. These Neuropterous insects are parasitic on the eggs of spiders of different species during the larval state, but the adults are predatory on a variety of insects.

14776. **MacKerras, I. M.** The Jackson Lecture. Australia's Contribution to our Knowledge of Insect-borne Disease. *Med. J. Aust.*, i, 35th year, No. 1, Feb. 7, 1948, 157–167, bibliography.—The author traces the history of medico-entomology in Australia, dividing it into three periods, from the early work of Dr. T. L. Bancroft in Queensland to that of present-day medical men collaborating with entomologists. A brief review is given of the researches into tropical diseases and the allied study of their insect and arachnid vectors during the war years, in Australia and the Pacific Islands, by Australian and U.S. medical units. A lengthy bibliography is appended under the headings of the chief insect-borne diseases and medical entomology.

14777. **MacKerras, Mary J., and Roberts F. H. S.** Experimental Malarial Infections in, Australasian Anophelines. *Ann. Trop. Med. Parasit.*, Liverpool, xli (3–4), Dec., 1947, 329–356.—The methods employed in rearing Australasian Anophelines for the transmission of Melanesian strains of human malaria are described, and observations are recorded on their behaviour in captivity and susceptibility to infection.

14778. **Norris, K. R.** Seasonal Severity of the Attack of the Red-legged Earth Mite (*Halotydeus destructor*) on Subterranean Clover. *J. C.S.I.R.*, xxi (1), Feb., 1948, 7–15.

14779. **Oke, C. G.** Description of a New Species of Case Moth (Lepidoptera, Psychidæ). *Mem. Nat. Mus. Melb.*, No. 15, 1947 (1948), 178–179, pl. xv—*Plutorectis cæspitosæ* sp.n., ♂♀. V.: Bogong High Plains, Mt. Hotham (type loc.); N.S.W.: Mt. Kosciusko. Feeding on *Poa cæspitosa* G. Forst.

14780. **Oldroyd, H.** On the Origin and Identity of *Chrysops testaceus* Macq. (Dipt., Tabanidæ), described as from Tasmania. *Ent. Mo. Mag.*, lxxxiii (1002), Nov., 1947, 277–278.—Points out that *Chrysops testaceus* Macq. is wrongly described as from Tasmania, where it was said to have been collected by Verreaux, but from Central America, and so should be removed from the Australian list.

14781. **Powning, R. F.** The Sub-surface Atmosphere of Wheat Infested with *Rhizopertha dominica* F. *J. C.S.I.R.*, xx (4), Nov., 1947, 475–482, tfs. 1–4.

14782. **Rayment, T.** Notes on Remarkable Wasps and Bees, with Specific Descriptions. *Aust. Zool.*, xi (3), Feb. 11, 1948, 238–254, pls. xix-xxi, tfs. 1–2.—

14783. **Rayment, T.** Observations on Thrips, with Descriptions of a New Species. *Aust. Zool.*, xi (3), Feb. 11, 1948, 255–258, pls. xxii-xxiii.—Order Thysanoptera.

14784. **Rayment, T.** New Bees and Wasps. Part vii. Two Undescribed Species of *Exoneura*, with Notes on Recent Collectings of several other *Exoneuræ* and the Extraordinary Appendages of Their Larvæ. *Vict. Nat.*, lxv (4), Aug., 1948, 85–91, tfs. 1–9.

14785. **Roberts, F. H. S., and O'Sullivan, P. J.** Studies on the Behaviour of Adult Australasian Anophelines. *Bull. Ent. Res.*, xxxix (1), May, 1948, 159–178, 1 fig.—Observations are recorded on the habits and behaviour of wild adult *Anopheles amictus hilli* and *A. punctulatus farauti*

at Cairns, N.Q., and of the two subspecies and intermediate forms of *A. punctulatus* in New Guinea.

14786. **Shanahan, G. J., and Morley, F.** B.H.C. (Benzine Hexachloride) as a Blowfly Dressing. *Agric. Gaz. N.S.W.*, lviii (12), Dec., **1947, 660–672**

14787. **Shanahan, G. J., and Morley, F. H. W.** Sheep Blowfly Control. Jetting with B.H.C. Experiments at Trangie and Bellata. *Agric. Gaz. N.S.W.*, lix (5), May, **1948, 271–273**, illustr.

14788. **Shanahan, G. J., and Shelton, A. B.** Cheese Mite Control. Use of Dichlor-ethyl Ether as a Fumigant. *Agric. Gaz. N.S.W.*, lix (7), July, **1948, 381–383**, illustr.

14789. **Smith, W. A.** Banana Rust Thrips Control. *Q'ld. Agric. J.*, lxv (5), Nov., **1947, 315–318.**

14790. **Smith, J. H., and Caldwell, N. E. H.** Army Worm and Other Noctuid Outbreaks during 1946–47. *Q'ld. Agric. J.*, lxv (6), Dec., **1947, 396–401.**

14791. **Southcott, R. V.** Larval Smarididæ (Acarina) from Australia and New Guinea. *Proc. Linn. Soc. N.S.W.*, **1947**, lxxii (5–6), 15 Jan., **1948, 252–264**, tfs. 1–8.—A key is given to the larval genera referred to family Smarididæ. Two W. Australian species, ***Hauptmannia westraliensis*** Wom. and *H.* ***mullewænsis*** are redescribed. The two European species form a compact group with *H. aitapensis* n.sp. from New Guinea, while the W.A. form diverge. A new genus and species, ***Clipeosoma copiolarum***, are recorded from New Guinea.

14792. **Taylor, K. L., and Hadlington, P. M.** Forest Insect in New South Wales. *N.S.W. Forest Rec.*, Sydney, i (1), Jan., **1948, 42–47**, tfs. 1–8.—The Mottled Cup-moth, ***Doratifera vulnerans***, attacks ***Eucalyptus*** spp., *Tristania conferta*, descr., life-cycle, and control. The Pine Bark Weevils, ***Aesiotes notabilis***; *A.* ***leucurus***, life-cycle, habits, control.

14793. **Tiegs, O. W.** The Metamorphosis of Insects. *Vict. Nat.*, lxiv (9), Jan., **1948, 170–171.**

14794. **Waterhouse, D. F.** Spray Tests against Adult Mosquitoes. i. Laboratory Spray Tests with Culicine (***Culex fatigans***) Adults. *Bull. C.S.I.R.*, Melbourne, No. 219, **1947, 9–27.**

14795. **Waterhouse, D. F.** The Effect of Colour on the Numbers of House Flies Resting on Painted Surfaces. *Aust. J. Sci. Res.*, (B) i (1), Feb.. **1948, 65–75**, fig. 1.

14796. **Waterhouse, D. F., and Atherton, D. O.** Spray Tests against Adult Mosquitoes. ii. Spray Tests with Anopheline (***Anopheles punctulatus farauti***) Adults. *Bull. C.S.I.R.*, Melbourne, No. 219, **1947, 29–40**, pls. i–ii.

14797. **Wharton, R. H.** Simuliidæ (Diptera, Nematocera) from New Guinea, with the Description of One New Species. *Proc. Linn. Soc. N.S.W.*, **1947**, lxxii (5–6), 15 Jan., **1948, 357–366**, 23 tfs.—***Simulium ornatipes*** Skuse, 1890, Syn. ***Chelocnetha biroi*** Enderlein, 1936. Type loc., Skuse, Darling River, N.S.W.; type loc. Enderlein, Sydney or New Guinea. Distr.: W.A., S.A., N.S.W., Q., Port Moresby, New Guinea.

14798. **Zeck, E. H.** Two New Species of Australian Dryopoidea (Coleoptera). *Aust. Zool.*, xi (3), Feb. 11, **1948, 277–279**, tfs. 1–4.—***Austrolimnius isdellensis*** sp.n., N.W. Austr.: Isdell River. *Kingolus davisi* sp.n. N.Q.: Wild River, Ravenshoe. Material collected by the late Dr. Consett Davis.

ZOOLOGY.

Hon. Abstractor: A. Musgrave.

14799. **Baylis, H. A.** The Nematode Genus *Dujardinæcaris* (nom. nov. pro *Dujardinia*) in Crocodilia, with a Description of a New Species. ***Ann. Mag. Nat. Hist.***, xiv (110), Feb. (Publ. 10 Dec., **1947**), **123–134**, tfs. 1–7.—*D. australiensis* (Baylis, **1931**), host: *Crocodilus johnstoni*, Australia.

14800. **Baylis, H. A.** On Two Nematode Parasites of Fishes. *Ann. Mag. Nat. Hist.*, xiv (113), May, **1947** (Publ. Feb. 4, **1948**), **327–335**, tfs. 1–4.—*Dichelyne* (?) *laticeps* sp.n. Host: Spotted toadfish, *Tetraodon hispidum*, Cleveland Bay, N.Q.

14801. **Bearup, A. J.** Observations on the Life Cycle of *Diphyllobothrium* (*Spirometra*) *erinacei* in Australia (Cestoda: Diphyllobothriidæ). *Aust. J. Sci.*, x (6), 21 June (=22 July, **1948**), **183–184.**

14802. **Boehm, E. F.** Crows and Blowflies. *S. Aust. Nat.*, xxiv (1), Sept. 2, **1946**, 11.—Concludes that the birds perform a good service by reducing the available breeding grounds of sheep blowflies generally. All three species of crows occur in South Australia, *Corvus coronoides*, *C. bennetti* and ***C. cecilæ***.

14803. **Boehm, E. F.** Breeding of the Little Crow, with Particular Reference to South Australia. ***S. Aust. Ornith.***, xviii (8), Jan. number (issued March 22, **1948**), 71, 80.

14804. **Bourke, P. A.** Notes on the Rate of Loss amongst Eggs and Nestlings, with Notes on Some Species. ***Emu***, xlvii (5), May, **1948, 321–330**, pls. 23–25.

14805. **Butcher, A. D.** Quinnat Salmon in Victorian Inland Waters. *Fisheries and Game Dept., Victoria, Fisheries Pamph.*, No. 4, 28 pp., 13 tfs., 1947.—This species of Pacific Salmon, *Onchorhynchus tschawytscha*, was introduced into Victoria during the period 1872–1880. Notes on the results of stocking lakes and upon age and growth are given.

14806. **Condon, H. T.** South Australian Birds. 1. Water Birds. *S. Aust. Nat.*, 24 (1) Sept., **1946, 1–9**, illustr.

14807. **Condon, H. T.** South Australian Birds. Part iv. Ducks, Hawks, Owls. *S. Aust. Nat.*, xxiv (4), April, **1948, 1–10**, illustr.

14808. **Cotton, B. C.** Some Rare Southern Australian Shells. *S. Aust. Nat.*, xxiv (1), Sept. 2, **1946, 13–16**, illustr.—A new genus, *Notovoluta*, is proposed for ***Voluta kreuslerœ*** Angas, 1865.

14809. **Cotton, B. C.** Australian Recent and Tertiary Cypræcea (Cowries). *S. Aust. Nat.*, xxiv (4), April, **1948, 11–15.**

14810. **Crowcroft, P. W.** Notes on *Anthobothrium hickmani*, a new Cestode from the Tasmanian Electric Ray (*Nareine tasmaniensis* Richardson). *Pap. Proc. R. Soc. Tasm.*, **1946 (1947), 1–4**, tfs. 1–5.

14811. **Crowcroft, P. W.** Some Digenetic Trematodes from Fishes of Shallow Tasmanian Waters. *Pap. Proc. R. Soc. Tasm.*, 1946 (1947), 5–25, tfs. 1–15.

14812. **Finlayson, H. H.** On the Weights of Some Australian Mammals. *Trans. R. Soc. S. Aust.*, lxxi (2), Dec., 1947, 182–194.

14813. **Finlayson, H. H.** Greenly Island, South Australia. *S. Aust. Ornith.*, xviii (8), Jan. number (issued March 22, 1948), 72–73, cover picture.—Description of island, flora, birds, 2 spp. of lizards, insect life abundant.

14814. **Fowler, S.** Aerial Census of Pied Cormorants at Shark's Bay. *W. Aust. Nat.*, i (4), March, 1947, 69–73, pl.

14815. **Fyfe, Marion L.** The Reproductive Organs of *Geoplana sanguinea* Moseley. *Rec. Aust. Mus.*, xxii (1), June 30, 1948 (= July 26), 64–66, tf. 1.—This land planarian has a wide range over eastern and southern N.S.W., V. and Tasmania, and specimens were selected from four widely separated localities with a view to showing variation in local forms. Reference is made to the external characters and the reproductive organs described in detail.

14816. **Gudger, E. W.** Stomach Contents of Tiger Sharks, *Galeocerdo*, Reported from the Pacific and Indian Oceans. *Aust. Mus. Mag.*, ix (8), July–sept. (Sept. 30, 1948), 282–287, illustr.

14817. **Gwynne, A. J.** Notes on the Brown Honeyeater [*Gliciphila indistincta*]. *Emu*, xlvii (3), Jan., 1948, 161–164, pl. 11.—Found in mangroves and brush.

14818. **Hardy, Margaret H.** The Group Arrangement of Hair Follicles in the Mammalian Skin. Part i. Notes on Follicle Group Arrangement in Thirteen Australian Marsupials. *Proc. R. Soc. Q'ld.*, 1946, lviii, No. 8, issued separately 27 Oct., 1947 (vol. issued 17 Nov., 1947), 125–148, pls. iii-ix, 2 tabs.

14819. **Harley, K. S.** Avifauna of the Esk-Somerset Dam District. *Q'land Nat.*, xiii (5), March, 1948, 84–87.—Lists the birds (53 species) of the district.

14820. **Harwood, P. D.** *Strongyluris davisi* n.sp. (Nematoda), from the Stomach of a Lizard, *Diporiphora australis*. *Proc. Linn. Soc. N.S.W.*, 1947, lxxii (5–6), 15 Jan., 1948, 311–312, 1 tf.—From the Five Islands, near Wollongong, N.S.W.

14821. **Hunt, R. A.** A Key to the Identification of Australian Snakes (other than Blind Snakes, Rock Snakes and Pythons, File Snakes, and Sea Snakes). *Vict. Nat.*, lxiv (8), Dec., 1947, 153–167.

14822. **Hickman, V. V.** *Pontobdella tasmanica* nom. nov. (Hirudinea). *Pap. Proc. R. Soc. Tasm.*, 1946 (1947), 27.

14823. **Iredale, T.** A Check List of the Birds of Paradise and Bower-birds. *Aust. Zool.*, xi (3), Feb., 1948, 161–189.

14824. **Iredale, T.** Bullock's Museum. *Aust. Zool.*, xi (3), Feb., 1948, 233–237, pls. xvi-xviii, tf. 1.—Gives the history of this Museum, and refers to Australian animals and birds which found their way into this collection. The 17 editions of *A Companion to Mr. Bullock's Museum*, which appeared between 1799–1816, are reviewed. About six of these are in Australian libraries.

14825. **Johnston, T. H., and Beckwith, Anne C.** Larval Trematodes from Australian Freshwater Molluscs. Part xii. *Trans. R. Soc. S. Aust.*, lxxi (2), Dec. 1, 1947, 324–333, tfs. 1–8.—*Cercaria ancycli* n.sp., a parasite of *Ancylus australicus* and *Americana pyramidata*, is described and figured. *Metacercaria* and life cycle are unknown. *Cercaria lophosoma* n.sp., a parasite of *Notopala hanleyi*, is also described and figured. It belongs to Sewell's group, *Lophocercaria*, and is closely related to the cercaria of *Sanguinicola*.

14826. **Laseron, C. F.** The Zoo-geographical Problem of Port Jackson. Part ii. Classification of Habitats. *Aust. Zool.*, xi (3), Feb., 1948, 190–203, tfs. 1–2.—In this paper the author deals with those factors likely to restrict the distribution of species to certain localities and thus produce defined ecological communities. The factors here dealt with are temperature, light and pressure, salinity, food and protection, ocean and tidal currents, nature of the sea bottom.

14827. **Laseron, C. F.** New South Wales Marginellidæ. *Rec. Aust. Mus.*, xxii (1), June 30 (= July 26, 1948), 35–48, pls. v-vi, tf. 1.—In the present paper 45 species and three varieties are dealt with, and four of Hedley's list are regarded as doubtful. Fifteen new species are added from New South Wales.

14828. **Marshall, A. J.** The Breeding and Distribution of *Erythrura trichroa* in Australia. *Emu*, xlvii (4), March, 1948, 305–310, map, pl. 22.

14829. **Mayr, E.** Geographic Variation in the Reed-Warbler. Notes on Australian Birds. iii. *Emu*, xlvii (3), Jan., 1948, 205–210.—*Acrocephalus arundinaceus orientalis* T. and S. Melville Is., extra-limital. *A. a. gouldi* Dubois, S.W. corner, W. Austr. *A. a. carteræ* Mathews, W. Kimberley Dist. *A. a. australis* Gould, the Australian Reed Warbler, S. Australia and E. Australia, mostly coastal. *A. a. cervinus* De Vis, N. Q'land and extra-limital.

14830. **Morris, Muriel C.** Life-history of an Australian Crustacean, *Acetes australis* (Decapoda, Tribe Panæidæ). *Proc. Linn. Soc. N.S.W.*, lxxiii (1–2), 15 May, 1948, 1–15, 73 tfs.—A detailed study is given of the larval stages of this prawn, which occurs in estuarine waters and coastal lakes influenced by the tides. Unlike certain commercial species of Penæid prawns, whose young may occur in company with *Acetes australis*, the adults do not go to sea to breed.

14831. **McGill, A. R.** Field Notes on Two Rare Migrant Waders. *Emu*, xlvii (5), May, 1948, 357–362.—Oriental Dotterel, *Charadrius veredus*, recorded for the Sydney district for the first time since 1908. The Black-tailed Godwit, *Limosa limosa*, observed at Cook's River, near Sydney, though this bird is not represented in the Australian Museum collection.

14832. **McNamara, E.** Birds of the Illawarra. *Aust. Nat.*, xi (7), May, 1948, 191–210.

13833. **O'Brien, B. R. A.** Studies in the Metabolism of Normal and Regenerating Tissue of the Earth-Worm. Part i. Factors Affecting the Endogenous Oxygen Consumption of Normal and Regenerating Muscle Tissue. *Proc. Linn. Soc. N.S.W.*, 1947, lxxii (5–6), 15 Jan., 1948, 367–378, 8 tfs.

14834. **Pearson, J.** Presidential Address. Some Problems of Marsupial Phylogeny. *Rpt. 25th Meeting A.N.Z. Ass. Adv. Sci.*, Adelaide, Aug., 1946 (1947), **71–102, tfs. 1–3.**

14835. **Plumb, W. (the late).** A Nesting Season in a Wellard Paddock. *Emu*, xlvii (4), March, **1948, 291–303.**—While head-teacher at Wellard school, 17 miles south of Fremantle, W.A., observations were made on the birds breeding in the 75-acre paddock surrounding the school. The notes which were incomplete, owing to the death of the author, have been edited by E. H. Sedgwick.

14836. **Pope, Elizabeth C.** "Sydney Coral" is a Worm. *Aust. Mus. Mag.* ix (7), Jan.-June (June 14 = July 7, 1948), 235–240, illustr.—*Galeolaria cæspitosa* (Polychæta); among the tubes of this worm occur *inter alia* the Stalked Barnacle, *Iola quadrivalvis*, the Marine Spider, *Desis crosslandi*, the bivalve, *Lasæa australis*, and *Onchidium patelloides*.

14837. **Richardson, L. R.** Second Report on Herniation in *Hyla aurea*. *Copeia*, 1947, No. 4 (Dec. 30, 1947), 255–258.—This Australian frog has been introduced into New Zealand and has been in the Wellington district for at least 30 years. It was first introduced into N.Z. in 1867. The author attributes the abnormal development of the reproductive system to seasonal influence due to peculiar local climatic conditions.

14838. **Sandars, Dorothea F.** Pseudomicrocotyle, a New Monogenetic Trematode. *Proc. R. Soc. Q'ld.*, 1946, lviii, No. 9 (issued separately 27 Oct., 1947, vol. issued 17 Nov., 1947), 149–152, pl. x.—*Pseudomicrocotyle elagatis* nov. gen. et sp. from gills of *Elagatis bipinnulatus* (Stead), popularly termed the Runner, near Moreton Bay, Q'land, coast.

14839. **Sandars, Dorothea F.** Fish at Somerset Dam, Stanley River. *Q'land Nat.*, xiii (5), Mar., **1948, 88–90.**

14840. **Serventy, D. L.** The Birds of the Swan River District, Western Australia. *Emu*, xlvii (4), Mar., 1948, 241–286, pl. 18, maps.

14841. **Shipway, B.** Fresh Water Fishes of the Barron River. *N. Q'land Nat.*, Cairns, xv (85), Dec., 1947, 9–13, illustr.—Toxotidæ: *Toxotes chatereus* (H. Buchanan), *Therapon unicolor* (Gunther). Gerridæ: *Gerres punctatus* Cuv. and Val. Scorpænidæ: *Notesthes robusta* (Gunther). Scatophagidæ: *Scatophagus ætate-varians* De Vis. *S. argus* (L.), *Ophiocara aporos* Bleeker. Gobiidæ: *Glossobobius giuris* (Buchanan), *Mogurnda mogurnda adspersus* (Castelnau).

14842. **Shipway, B.** Fresh Water Fishes of the Barron River. *N. Q'land Nat.*, Cairns, xv (86), March, 1948, 20–21, fig.—*Kurandopogoon blanchardi* Whitley. Eleotridæ: *Carassiops compressus* (Ogilby). Cyprinodontidæ: *Gambusia affinis holbrookii* (Girard). Introduced Mosquito fish.

14843. **Thomas, D. A. G.** Birds Seen in the Northern Territory. *S. Aust. Ornith.*, xviii (7), Oct., 1947 (issued Jan. 9, 1948), 62–65.

14844. **Thomson, J. M.** Some Chætognatha from Western Australia. *J. R. Soc. W. Aust.*, xxxi, 1944–45 (April 9, 1948), 17–18.—Records four species: *Sagitta minima* Grassi, 1881; *S. enflata* Grassi, 1881; *S. robusta* Doncaster, 1902; *S. pipunctata* (Quoy and Gaimard, 1827).

14845. **Thomson, J. M.** The Chætognatha of South-eastern Australia. (Division of Fisheries Report No. 14). *C.S.I.R. Bull.* No. 222, 1947, 1–43, 8 figs.—The identity of the species of Chætognatha present in the plankton of south-eastern Australian waters is discussed. A classification of maturity stages in Chætognaths is suggested. Grouping of the epiplanktonic species into tropical, temperate and cold-water forms is possible. Deep-water species are not so divisible. Tropical, temperate and cold-water forms are distinguishable. Tropical forms do not extend into Bass Strait.

14846. **Thomson, J. M., and Shipway, B.** Extension of the Australian Breeding Range of *Pterodroma macroptera*. *Emu*, xlvii (5), May, 1948, 349–352.

14847. **White, S. R.** Observations on the Mountain Devil (*Moloch horridus*). *W. Aust. Nat.*, i (4), March, 1947, 78–81, pl.

14848. **Whitley, G. P.** The Fluvifaunulæ of Australia, with Particular Reference to Freshwater Fishes in Western Australia. *W. Aust. Nat.*, i (3), Dec. 15, 1947, 49–53, tfs. 1–2.—Figures King River Perchlet, *Nannatherina balstoni* Regan, 1906, from fresh-water creek, Albany dist., W.A. Lists fresh-water fishes of W. Australia.

14849. **Whitley, G. P.** New Sharks and Fishes from Western Australia. Part iv. *Aust. Zool.*, xi (3), Feb. 11, 1948, 259–276, pls. xxiv-xxv, tfs. 1–7.

14850. **Whitley, G. P.** A New Aquarium Fish from North Queensland. *Aust. Zool.*, xi (3), Feb. 11, 1948, 279–280.—Terapontidæ: *Leiopotherapon suavis* sp.n. N.Q.: Coen District.

14851. **Whitley, G. P.** The Giant Herring. *Aust. Mus. Mag.*, ix (7), Jan.-June (June 14 = July 7, 1948), 252, illustr.—Also called the Chiro or Banana Fish, *Elops* (*Gularis*) *australis*. Tropical seas south to Mandurah, W.A., and Sydney, N.S.W.

14852. **Whitley, G. P.** Studies in Ichthyology. No. 63. *Rec. Aust. Mus.*, xxii (1), June 30 (= 26 July, 1948), 70–94, tfs. 1–11.—A new family, *Tripterophycidæ*, is proposed for the genus *Tripterophycis* Boulenger, 1902, and a new species, *T. intermedius*, from the Great Australian Bight and other S. Australian and Victorian localities, is described and figured. In addition, 15 new genera and 16 new spp. are described and figured, while genera and spp. previously described are referred to.

14853. **Whitley, G. P.** The Oil Fish in Australia. *Aust. Mus. Mag.*, ix (8), July–Sept. (Sept. 30, 1948), 256–258, illustr.—The Oil Fish, *Ruvettus tydemani*, originally recorded from the East Indies and Hawaii, is here cited from Australia for the first time, having been secured by a trawler from 50 fathoms of water, 100 miles south of Gabo Island, V.

14854. **Whitlock, F. L.** Animal Life in Mangroves. *W. Aust. Nat.*, i (3), Dec. 15, 1947, 53–56.—Deals chiefly with birds.

BIOCHEMISTRY.

Hon. Abstractor: G. F. Humphrey.

14855. **Austin, C. R.** The Metabolism of Thiamin in the Sheep. *Aust. J. Exp. Biol. Med. Sci.*, xxv, 1947, 149.—Factors affecting the thiamin requirement of sheep were studied. It was concluded that provided a preponderance of thiamin-synthesizing microflora is maintained in the rumen, it is most unlikely that a thiamin deficiency would ever result.

14856. **Austin, C. R., Whitten, W. K., Franklin, M. C., and Reid, R. L.** The Effect of Hexoestrol on the Food Intake of Sheep. *Aust. J. Exp. Biol. Med. Sci.*, xxv, 1947, 343.—Inappetance could be produced only by administration of hexoestrol every two or three days.

14857. **Bolliger, A., and McDonald, Norma.** The Glycogen Content of Rabbit Hair. *Aust. J. Exp. Biol. Med. Sci.*, xxvi, 1948, 459.—Glycogen was shown to be present in rabbit fur by chemical and encymatic methods.

14858. **Bolliger, A., and McDonald, Norma.** Water Extractable Constituents of Mammalian Hair. *Aust. J. Sci.*, x, 1947, 82.—Uric acid, glycogen and citric acid are found in hot water extracts of rabbit fur.

14859. **Clark, A. M.** Carbonic Anhydrase in *Arenicola marina*. *Nature*, clxii, 1948, 191.—Carbonic anhydrase occurs in the blood plasma of this organism; of all the tissues examined the oesophageal pouches contain the largest amount.

14860. **Corkill, A. B., and Nelson, J. F.** The Influence of Fructose on the Utilization of Glucose by Isolated Muscle. *Aust. J. Exp. Biol. Med. Sci.*, xxv, 1947, 347.—Under the influence of insulin, fructose can promote increased glycogen formation in muscle strips.

14861. **Ennor, A. H., and Stocken, L. A.** The Distribution of Acid-soluble Phosphates in the Fatty Liver. *Biochem. J.*, xlii, 1948, 549.—Guinea-pigs were treated with CCl_4 and the change in distribution of acid-soluble phosphate followed; this fraction increased after the treatment and the increase was shown to be due primarily to adenosine polyphosphates and phosphocreatine.

14862. **Ennor, A. H., and Stocken, L. A.** The Estimation of Creatine. *Biochem. J.*, xlii, 1948, 557.—Sulphydryl compounds interfere with the α-naphthol-diacetyl reaction for creatine. This effect can be largely overcome by treatment with p-chloromercuribenzoate.

14863. **Fantl, P., and Rome, M. N.** The Relationship between Calcium and Citrate in Fowl's Blood. *Aust. J. Sci.*, x, 1947, 19.—The excess citrate in blood is derived from organs other than bone.

14864. **Foulkes, E. C., and Lemberg, R.** The Inhibition of Catalase by Ascorbic Acid. *Aust. J. Exp. Biol. Med. Sci.*, xxvi, 1948, 307.—Copper is needed for the inhibition of catalase by ascorbic acid; the inhibition is partly reversed by carbon monoxide. A discussion is given of the possible inhibitory mechanisms.

14865. **Gilmour, D.** Myosin and Adenylpryophosphatase in Insect Muscle. *J. Biol. Chem.*, clxxv, 1948, 477.—More than half of the total apyrase of grasshopper muscle is present in an aqueous extract. Preparations of adenylpyrophosphatase split two phosphate groups from adenosinetriphosphate; there is also present an enzyme which hydrolyses sodium pyrophosphate.

14866. **Goulston, Daphne.** Separation of Two Different Amylases from the Pancreas. *Aust. J. Sci.*, x, 1947, 85.—Enzymes similar to α- and β-malt amylases were prepared from commercial dried pancreas.

14867. **Griffiths, M.** The Mechanism of the Hypoglycæmic Action of Alloxan. *Aust. J. Exp. Biol. Med. Sci.*, xxvi, 1948, 339.—Injection of alloxan into the pancreas of the guinea-pig produces hypoglycæmia; this effect is not given by subcutaneous or intravenous injection. Alloxan hypoglycæmia does not occur in recently pancreatectomized rabbits. It is concluded that alloxan hypoglycæmia is pancreatic in origin.

14868. **Hird, F. J. R., and Trikojus, V. M.** Paper Partition Chromatography with Thyroxine and Analogues. *Aust. J. Sci.*, x, 1948, 185.—One-dimensional chromatograms were used on thyroxine and related compounds.

14869. **Holden, H. F.** On the Decomposition of Methæmoglobin by Hydrogen Peroxide. *Aust. J. Exp. Biol. Med. Sci.*, xxv, 1947, 355.—Various reaction products were isolated from mixtures of hydrogen peroxide and methæmoglobin.

14870. **Humphrey, Beverley, and Humphrey, G. F.** Succinic Dehydrogenase in Protozoa. *Nature*, clix, 1947, 374.—Homogenates of *Paramecium candatum* contain succinic dehydrogenase essentially similar to that found in other animals.

14871. **Humphrey, Beverley, and Humphrey, G. F.** Studies in the Respiration of *Paramecium candatum*. *J. Exp. Biol.*, xxv, 1948, 123.—Details are given of a "Macro" Cartesian Diver Respirometer. The effects of pH, cyanide, azide and methylene blue on the oxygen consumption of homogenates of *Paramecium candatium* were determined and the results discussed in relation to the general metabolism of the organism.

14872. **Humphrey, G. F.** The Succinoxidase System in Oyster Muscle. *J. Exp. Biol.*, xxiv, 1947, 352.—Cytochrome oxidase is present in the adductor muscle of *Saxostrea commercialis*. The muscle is also able to oxidise succinic acid; the effects of several inhibitors are reported.

14873. **Humphrey, G. F.** The Effect of Narcotics on the Endogenous Respiration and Succinate Oxidation in Oyster Muscle. *J. Mar. Biol. Assn.*, xxvii, 1948, 504.—In general, both endogenous respiration and oxidation of succinic acid are inhibited by narcotics; this is in contrast with other tissues.

14874. **Humphrey, G. F., and Mann, T.** Citric Acid in Semen. *Nature*, clxi, 1948, 352.—The distribution of citric acid in the semen of various animals is given. Also the occurrence of fructose and citric acid in the accessory reproductive organs of the rat was worked out.

Surveying Degree Course

A degree course in Surveying will be introduced at the University of Melbourne in 1949. The Victorian Government will provide £2,000 a year towards staff and running costs and eventually £20,000 for buildings and equipment. All mainland universities other than Sydney now have courses leading to a degree in Surveying. Practitioners of the field sciences, as well as planners, designers and administrators in all parts of the world, are becoming increasingly conscious of lack of large-scale maps: this is nowhere more severe than in Australia. Modern advances in cartographic science require education considerably beyond the standards hitherto prescribed for Australian surveyors.

Research School of Physical Sciences

Professor Marcus L. Oliphant, F.R.S., has been appointed Director of the Research School of Physical Sciences at the National University, Canberra. He will take up his duties when the University has been established as a working body. The School is to have professorial chairs in Experimental Physics, Theoretical Physics and Radiochemistry. Readers will be appointed in Nuclear Physics, Physical Techniques, Theoretical Physics and Radiochemistry. The Professor of Experimental Physics will share with the Director the responsibility for the programmes of investigation carried out in the laboratories. The Professor of Radiochemistry, in addition to having charge of a Division of the School, will advise and assist the staff of the John Curtin School of Medical Research.

The Vice-Chancellor, Professor Douglas Copeland, states that all members of the staff will maintain a close liaison with workers in related subjects in the existing universities in Australia and will be prepared to give short courses of lectures in the Honours Schools of their Physics Departments.

A Chief Technical Officer, S. R. Cornick, and a Senior Technical Officer, M. P. Edwards, have already been appointed to the Research School. They will work for the present with Professor Oliphant at Birmingham, but Mr. Cornick will be stationed in Australia from 1949, to assist in the planning of buildings and the design and purchase of equipment. Applications close on 31 December, 1948, for the position of Laboratory Manager in the School, with the function of managing the general internal business and supervising the clerical and technical staff. During the period of construction he will supervise installation of equipment in the laboratories. Applicants are required to be graduates with knowledge of the commercial aspects of instrument and engineering industries and some knowledge of laboratory construction and layout. The salary is £1,200 per annum, with superannuation.

The National University

Intensive efforts are being made to ensure that the work of the Australian National University will commence early in 1951, as planned when the University Act was passed in 1946. Buildings to be constructed immediately will include a residential college to be known as "University House", laboratories for the John Curtin School of Medical Research and for the Research School of Physical Sciences, and some houses and apartments for the technical and administrative staff. These buildings will conform to the ultimate plan for the University site.

Among the interim developments effected during the establishment period, a Division of Biochemistry in the Medical School has been established by arrangement with the Health Department, at the Commonwealth Serum Laboratories in Melbourne. The Chemistry Division of the Medical School will shortly be established, with temporary laboratory facilities in an Australian city. The University Library has been established in temporary quarters in Melbourne and a beginning has been made in collecting books and periodicals. It will later be housed temporarily in the Canberra buildings at present occupied by the Department of Post-War Reconstruction. Permanent accommodation for the National University Library will be part of the second unit of the building programme.

Two research fellowships in the Social Sciences will be awarded by the National University in 1949, to enable persons with considerable experience to undertake or complete a specific research project. Tenure will be for one or two years, at £900 a year, with travelling allowance.

Communications to the National University should be addressed to The Registrar, Australian National University, P.O. Box 168, City, Canberra, A.C.T.

Research in Melbourne

The Professorial Board of the University of Melbourne has prepared a statement on the principles of research policy. The Standing Research Committee is issuing a report of research undertaken in 1947–48. It has recommended that a handbook on research and higher degrees be published, to contain information on scholarships, facilities and regulations. Short accounts of research being conducted in the several departments are to be published from time to time in issues of the *University Gazette*. It is proposed to extend the course for the Bachelor of Science Degree to four years for all students, increasing it in both breadth and standard. It is proposed to appoint an independent lecturer within the Faculty of Science to teach foreign languages to post-graduate students.

The Degree of Doctor of Science has been awarded to Dr. A. L. G. Rees, of the C.S.I.R. Division of Industrial Chemistry. Dr. Rees,

who previously held the Degree of Doctor of Philosophy from London, received the award for a series of published papers on molecular spectroscopy, investigations on non-crystalline solids, the electron microscopy of keratin fibres and other investigations. The Degree of Doctor of Philosophy has been awarded to J. F. McCrea, M.Agr.Sc., for a thesis on work done at the Walter and Eliza Hall Institute of Medical Research—"Bacterial and Viral Enzymes Affecting Cell Structural Components" and "Inhibitors of Haemagglutination by Active and Heated Influenza Virus". Dr. McCrea is now studying mucopolysaccharides in relation to infectious disease under Dr. W. J. C. Morgan at the Lister Institute in London. The Degree of Doctor of Philosophy has also been awarded to Joyce D. Stone, of the Walter and Eliza Hall Institute of Medical Research. Dr. Stone has been engaged in research, under the direction of Professor Burnet, into the prevention of influenza virus infection in chick embryos and mice.

The 1949 scholarship of the Vera Scantlebury Brown Memorial Trust has been awarded to Dr. Margaret A. Mackie, who will study obstetrics and methods of ante-natal care in Great Britain.

University of Melbourne

Mr. E. J. C. Rennie, who has been on the teaching staff in engineering since 1915, has been appointed as Associate Professor of Mechanical Engineering. Mrs. Kathleen Fitzpatrick has been appointed as Associate Professor of History. Mrs. Fitzpatrick has published research upon Tasmanian history and upon the Tudor and Stuart periods. She has on several occasions taken acting charge of the Department of History in the University. Norman Richmond, of New Zealand, now at Canberra University College, has been appointed senior lecturer in Political Science. Other appointments include R. J. Storer as senior lecturer in Mathematics, K. H. Hunt as lecturer in Mechanical Engineering, R. Smith as lecturer in Metallurgy, and J. H. Chinner as senior lecturer in Forestry. Dr. J. S. Rodgers, who is Warden of the Mildura Branch, is at present visiting the United States; L. D. R. Pyke, senior lecturer in Chemistry, is acting-Warden.

The senior lectureship-in-charge of Political Science is to be converted into a professorship. A. J. Gaskin, lecturer in Geology, who has undertaken seismological observations since the closing of the Victorian Observatory, has been given the title of Seismologist in charge of the Seismological Station of the University.

Associate Professor Leeper is now abroad at the University of California, where he is engaged in research in soil chemistry. Associate Professor M. H. Belz has returned from the World Statistical Conference in Washington; he has been appointed Head of the newly-established Department of Statistics in the University. C. E. Palmer, senior lecturer in General Science, has resumed duties after a visit to the University of California. He accepted a short-term appointment there as visiting associate professor at the Institute of Geophysics and was engaged in meteorological research arising from the Bikini explosion observations.

Among a number of benefactions recently received are £960 in the estate of Dr. T. T. Dick, £577 from the W. L. Baillieu Trust, £390 in the name of the late Mrs. J. A. Thompson, a set of 250 books from Emeritus Professor Skeats, and £200 from F. H. Brunning Pty. Ltd. for the endowment of a prize for the best collection of insects by students in Agriculture II. A gift of £100 has been received from L. Rubenstein, as the first monthly instalment of £1,200 for research in the Department of Physiology. The City Council has donated £100 for the Department of Bacteriology.

The University is shortly to spend £52,000 in the purchase and adaptation of property for the housing of members of its staff. A fire which broke out in the Zoology School of the University, early in October last, caused damage estimated at £1,400. A few days later another fire in the cosmic ray research annexe near the Physics School of the University destroyed premises valued at £850, together with irreplaceable equipment and records.

A collection of stone implements and examples of primitive arts and crafts has been accumulated and descriptively catalogued by the Department of History. It contains the Groote Eylandt collection of bark paintings and other cultural examples donated by Peter Gray; Tasmanian stone implements presented by G. and A. Campbell Smith; wooden ritual boards (tjuringas), stone axes and scrapers from various parts of Australia; and a small New Guinea collection, which includes one of the famous human skulls from the Sepik River district. Specimens to illustrate material culture of primitive peoples from all parts of the world are being added. Because of lack of space, the collection is not exhibited; Dr. Leonhard Adam acts as curator.

David Syme Research Prize

The Syme Prize for 1948 has been awarded to K. L. Sutherland for his work on the "Chemistry and Physics of the Flotation Process". After working for his Master's degree under Dr. Wark upon flotation problems, Mr. Sutherland joined the C.S.I.R. as leader of the team working in flotation chemistry. In 1943 he shared the Grimwade Prize in Industrial Chemistry. During the current year Mr. Sutherland has been engaged in research under Professor Rideal in London, with a Davy Faraday Fellowship from the Royal Institution.

University of Western Australia

The deaths have occurred of Associate Professor P. H. Fraenkel, formerly Head of the Department of Electrical Engineering, and Mr. W. R. Baldwin Wiseman, formerly lecturer-in-charge of Hydraulics. Professor A. D. Ross has been re-appointed Professor of Physics for 1949. Other appointments include Dr. J. Miller as lecturer in Organic Chemistry, and Mrs. M. E. Finch (Miss M. E. Allen) as special lecturer in Zoology.

During the holding of the Australian Medical Congress in Perth the University conferred the Honorary Degree of Doctor of Science upon Professor F. M. Burnet, F.R.S.; Sir Henry Simpson Newland, the President of the Federal Council of the British Medical Association; Professor J. C. Spence, of the University of Durham; and Professor F. B. Walsh, of the Wilmer Institute of the Johns Hopkins University. It is now known that the Medical School of the University will not be founded for at least another two years. Twenty-five of the eighty students enrolled in First Year Medicine in the current year will be accommodated next year in the University of Adelaide. There are, however, twelve students in Second Year Medicine now doing second-year Science courses in the University of Western Australia, who wish to proceed with a medical course as soon as practicable.

The University has received gifts for the Institute of Agriculture Research and Development Fund, meteorological equipment given to the School of Engineering, and a gift of the library of the State Dental Board for the Faculty of Dental Science.

University of Tasmania

Teaching of Chemistry for the Degree of Bachelor of Science has recently been modified. Separate subjects of Organic Chemistry II and Inorganic Chemistry II will replace the former subject of Chemistry II and either or both may be included in the course. Chemistry III will consist of a choice of any three units chosen from Inorganic Chemistry, Systematic Organic Chemistry, Biochemistry, Industrial Chemistry, General Physical Chemistry, Organic Physical Chemistry, Thermodynamics and Electrochemistry. A suitable selection for Chemistry III may be made to follow either or both of the second-year courses.

Sabbatical leave for the year 1949 has been granted to Mr. G. C. Israel and for 1950 to Miss W. M. Curtis.

University of Queensland

A long-awaited circulating library of reference books for the use of External Students has now been established, with a donation of £350 and four hundred books from the Students' Union of the University and a grant of £300 for the current year from the University administration. It is hoped that the Library will bear the name of the late Thomas Thatcher, Director of External Studies from 1938. Former students and others are invited to make donations.

Miss Freda Bage has presented to the Department of Biology a collection of books, specimens, microscope slides and a microscope. The slides include those made by Miss Bage in her post-graduate work on *Sphenodon*. The Zinc Corporation Ltd. has donated £5,000 for research in mining, metallurgical or geological subjects, with particular reference to the mineral resources of Queensland.

Dr. W. H. Bryan has been appointed to the Chair of Geology. Professor Bryan is one of the original students of the University and in 1926 received its first award of the Degree of Doctor of Science. Acting Professor D. A. Herbert, who has been in charge of the Department of Biology since the death of Professor Goddard, and was first appointed lecturer in the department in 1924, has been appointed to the Chair of Botany. Professor Goddard was for four years Professor of Botany and Plant Pathology in the University of the Philippines. J. H. Lavery, a former Rhodes Scholar for Queensland, has been appointed to the Chair of Civil Engineering.

University of Sydney

Five appointments to professorial chairs were made at the beginning of November: Professor of Architectural Design and History, H. I. Ashworth, of Manchester and London; Professor of Geology, C. E. Marshall, of Birmingham and Nottingham; Professor of Zoology, P. D. F. Murray, originally of Sydney; Professor of Oriental Studies, J. K. Rideout, of Oxford and London; Professor of Pharmacology, R. H. Thorp, of London University and the Wellcome Physiological Research Laboratories, to be the first occupant of the chair.

Professor Marshall, who succeeds Professor Leo Cotton, has been particularly interested in coal research. He has worked with the British Iron and Steel Federation and the War Office, has advised the Government of Nova Scotia on coal development, and has filled the posts of Lecturer at Birmingham and Professor at Nottingham. Professor Murray, who succeeds Professor W. J. Dakin, is a son of the late Sir Hubert Murray (Lieutenant-Governor of Papua) and a nephew of Sir Gilbert Murray (formerly Regius Professor of Greek at Oxford). He was a Linnean Macleay Fellow in Zoology and has held various positions in the University of Sydney, Bedford College, London, and St. Bartholomew's Hospital Medical College. He held a Rockefeller Fellowship at the Universities of Freiburg and Cambridge, and from 1930 to 1936 was Smithson Research Fellow at Cambridge.

The Senate has received a gift of £420 from the N.S.W. Colliery Proprietors' Association for the encouragement during 1949 of third and fourth year students who wish to qualify for positions in the coal-mining industry; it is to be distributed in grants of £70. A gift

of £500 has been received from Broken Hill Associated Smelters Ltd. to promote research in fluidization now being carried out in the Department of Chemical Engineering. A gift of £200 has been received from the Rural Bank of N.S.W. to provide a magnetic wire recorder at the McGarvie Smith Animal Husbandry Farm. A gift of £100 has been received from Mr. Hermon Slade, Junior, for the Department of Chemical Engineering.

Mr. R. A. Champion has been appointed as Lecturer in Psychology, and Dr. A. L. Blakers as Senior Lecturer in Mathematics at New England University College.

Sydney Technical College

N. R. Davies, B.Sc. (London), A.R.I.C., has joined the staff as lecturer in Chemistry. Officers of the S.T.C. Chemical Society for the year 1948–49 include M. T. Walters as President and F. R. Morrison and J. W. G. Neuhaus as Hon. Secretaries. A. R. Penfold has retired from the position of Secretary after being in office continuously since the Society was founded 35 years ago. A presentation in recognition of his services was made at the meeting of the Society on 24 November.

Linnean Society of New South Wales

The Linnean Society has made the following appointments to Macleay Fellowships for 1949: Miss Judith Balmain, B.Sc., and Miss Adele Millerd, B.Sc., to Fellowships in Biochemistry; Miss Mary Hindmarsh, B.Sc., to a Fellowship in Botany. Miss Muriel Morris, B.Sc., who held a Fellowship in Zoology in 1948, has been re-appointed for 1949. All will be working in the University of Sydney.

Personal

Dr. A. A. Opik, formerly Professor of Stratigraphy and Palaeontology at the University of Tartu in Estonia, has joined the Commonwealth Bureau of Mineral Resources and will specialize in the palaeontology of the Lower Palaeozoic in Australia.

Dr. Frank Adcock recently arrived from India to take up appointment as head of the research organization of the Broken Hill Proprietary Co. at Newcastle, N.S.W. Previously he was professor of metallurgy at the Indian Institute of Science, Bangalore. From 1934 to 1945 he was director of science at the National Physical Laboratory.

G. F. Schaeffer has transferred from the University of Melbourne to the Bureau of Mineral Resources.

In the University of Birmingham, Professor H. W. Melville, F.R.S., has been appointed to the Maston Chair of Chemistry in succession to Sir Norman Haworth, F.R.S. Dr. K. Maher has been appointed to the newly-created Chair of Genetics.

In the University of Liverpool, Dr. R. M. Shackleton has been appointed to the George Hardman Chair of Geology. In the University of Cambridge, Georg Henrik von Wright, of Helsinki, has been appointed to the Chair of Philosophy. In the University College of North Wales (Bangor), Dr. Stanley Peat, F.R.S., and D. E. Litlewood have been appointed to the Chairs of Chemistry and Mathematics respectively.

Dr. Z. I. Kertesz, Professor of Chemistry in the Division of Food Science and Technology, New York State Agricultural Experiment Station, Cornell University, Geneva, has been granted sabbatical leave and has accepted a joint invitation from the C.S.I.R. Division of Food Preservation and Transport, the N.S.W. Branch of the Australian Chemical Institute, and the N.S.W. Food Technology Association for a six months' study of the biochemical aspects of food production and processing in Australia. He is also to give lectures in the capital cities and to be available to industry for consultation. Dr. Kertesz left Geneva early in November; his headquarters and mailing address are at the Chemistry Department, Sydney Technical College.

Zoology at Belfast: Professor T. T. Flynn

Professor T. T. Flynn is to retire at the end of the present session from the Chair of Zoology at the Queen's University, Belfast, which he has held since 1931. Born in Australia in 1883 and trained at Sydney under W. A. Haswell and J. P. Hill, he developed a natural interest in the anatomy and embryology and reproductive phenomena in marsupials. He maintained this interest throughout his university career, making valuable additions to knowledge in this subject. So recently as 1941, in collaboration with J. P. Hill, fundamental agreement in the mode of formation of the primary germ layers in monotremes and marsupials was demonstrated, while in 1947 strong support was given for the view of a similar mode of formation in birds and an incentive predicated for the re-examination of germ-layer formation in reptiles in the light of the work portrayed. Along with his interest in marsupials and their nearer allies, Flynn contributed work on the Pycnogonida of South Africa, describing ten new species; on corals of the Barrier Reef; on the invertebrate fauna of Tasmania; on rare and fossil Cetacea; and he demonstrated his interest in marine biology as leader of the Australian Antarctic Summer Expedition, 1912, and as sole Royal Commissioner for the Tasmanian Fisheries in 1915. In his retirement to Jamaica he hopes to utilize this latter experience in taking a serious interest in the marine biology and fisheries of the Caribbean area, as well as in meeting the demands of the British Museum for local biological material.

On graduating at the University of Sydney, Professor Flynn was awarded the University Medal and John Coutts Research Scholarship, and later he received the University Medal for his D.Sc. thesis. He was Macleay Fellow

of the Linnean Society of New South Wales in 1911 and Rockefeller Fellow during 1930–31; he was elected a member of the Royal Irish Academy in 1934. In the Second World War he was Chief Casualty Officer (Civil Defence), Belfast, and received the M.B.E. for his services. His many friends wish him a happy and fruitful retirement. (*Nature*, 24 July, 1948.)

Obituary

Professor D'Arcy Wentworth Thompson, for over sixty years Professor of Natural History in St. Andrews University, also a noted scholar in classics and mathematics.

Professor Thomas Parnell, at the age of 67. Professor Parnell was appointed as the first lecturer in Physics in the University of Queensland in the year 1911, and he occupied the Chair of Physics in that University from 1919.

Professor Henry Alcock

The late Professor Henry Alcock was appointed Lecturer in History and Economics in the University of Queensland in 1913 and in the year 1922 he became the first McCaughey Professor of History and Economics in the University. As a historian he coupled field research with library research. Even as a schoolboy he was carrying out independent research in the town of Bath and the neighbouring country, securing results which achieved text-book status. One of these was the discovery of a sunken road which accounted for hitherto unexplained aspects of the strategy of the battle of Lansdown. As far as teaching and administrative work permitted, he pursued the same bent towards topographical research in the wide field offered by the history of Queensland.

Professor Alcock was a Fellow of the Australian National Research Council and represented that body on the Council for Scientific and Industrial Research. He was a member of the Committee for Research in Social Sciences, established by the Australian Council for Educational Research. He was closely identified with the Historical Society of Queensland and was the first President of the Council for Social Agencies on its establishment in 1937. He was the first Chairman of the Queensland Educational Broadcasting Committee and was a member of the General Advisory Committee of the A.B.C. In earlier years he was responsible for the reorganization and spread of the Workers' Educational Association in Queensland.

At the time of his death Professor Alcock had continued active work through many years of illness and distress.

German Scientists in Australia

The Industrial Development Division of the Department of Post-War Reconstruction receives numerous requests for scientists from research institutions, universities and industrialists; it also receives many applications for positions in Australia by scientists and technicians in Germany. Recruiting of scientists in the United States zone of Germany has recommenced, but there is no certainty as to how long it will continue, as so many scientists and technicians are essential to the rehabilitation of Germany itself. The allocation of seventy-seven scientists to Australia has been approved by the Chiefs of Staff Mission, Washington; the number who have been brought to Australia now totals twenty-five.

Seventeen are working on projects which include the gasification of sub-bituminous coals. Reports have been made upon the gasification of coals at Yallourn, Leigh Creek and Moorlands, and initial investigations have been made upon the Collie fields and Tasmanian coals. A laboratory has been established by another scientist in the University of Melbourne for the micro-analysis of organic substances; the initial work is being done at the Munitions Supply Laboratories, the P.M.G.'s Research Branch and in the Western Australian Alunite Industry.

Work on lens computing and upon the design and production of optical instruments is being done by T. Feutiegal; A. H. Kamphausen is engaged as a technician in the production of glass apparatus for scientific purposes. Professor G. Jayme, who is Director of the Institute of Cellulose Chemistry at the University of Darmstadt, will spend three months in Australia to advise the paper industry and Government authorities on improved use of eucalyptus fibre for paper making. F. Ruf is available to advise industrialists in the installation of long-line communication equipment. Dr. G. Kaess, a specialist in treatment for improving the storage life of perishable foods, is employed in the C.S.I.R. Division of Food Preservation and Transport.

Science in Yugoslavia

The Government of Croatia has distributed awards in the fields of pure and applied science, in the development of peasant co-operatives and in the improvement of industrial output. Recipients include university professors, shock workers, technicians and co-operatives; among them are Professor F. Kogoj (Skin and Venereal Diseases), Professor F. Tuchan (Mineralogy) and Dr. Mayerhofer (Paediatrist, co-worker of Pirquet).

The Slovene Academy of Science (Ljubljana), the Yugoslav Academy of Science and Art (Zagreb), and the Serbian Academy of Science have each, in line with numerous meetings of people from all regions and numerous corporations, scientific, educational, cultural and business, issued a statement expressing regret at "all the slander and falsehoods which are being spread regarding the country and its leaders", and at "attacks pouring in from all sides, whereby great damage is obviously being inflicted upon Yugoslavia's prestige, peace and

progress". The Serbian Academy of Science affirms that the country's leaders have "tirelessly worked on the raising of culture and science as an essential condition for socialist reconstruction" and that "nowhere and on no occasion did any one of the State leaders deprecate, and still less belittle, the great significance of the closest friendship and closest co-operation with the Soviet Union, whose aid and whose sacrifices for the liberation of Yugoslavia our authority has always expressed with the deepest pride and gratitude. The Serbian Academy of Science most loyally joined in doing this in all its activities."

Ninety per cent. of all university students in Yugoslavia belong to the National Youth Organisation, in conjunction with which they "take part in voluntary working activities and have good results". It is claimed that the idea of the "eternal student" has disappeared from the universities, in that the majority now pass their examinations—e.g., 30,000 out of 42,000 candidates at the University of Belgrade last year. Six hundred and twenty students of this University graduated last year. It has an enrolment of 25,000 full-time students, with a teaching staff of 411, plus 243 juniors and teaching fellows. There is a library of 410,000 volumes to which 3,300 students subscribe. Over thirty per cent. of Yugoslav students receive financial aid from scholarships. The University of Zagreb was allotted £100,000 last year for student hostels, health and insurance. Buildings at mountain resorts are also being erected for student vacations.

With regard to scientific research, Yugoslav authorities have now decided that "we should assist the most gifted and most efficient students to commence research work while still at the university: this should be done according to their desires and abilities". It is reported that at the University of Belgrade "a group of student research workers has been formed and has published the first annual record of achievements". This University enrolled 4,200 new students in the year which commenced last September. The Government is giving major scholarships to encourage students to enrol in Veterinary Science (for cattle raising and research stations), in Architecture (for the State building programme) and in Arts (to provide teaching staff for the high schools and university). It is planned that the present ratio of one teacher to each 36 high school pupils and one to each 80 university students should be improved to 20 and 35 respectively. (Telegraphic Agency New Yugoslavia, *Newsletter*, *1*, 25–30.)

Prizes in Metallurgy

The Councils of the Institution of Mining and Metallurgy and of the Institute of Metals (London) have accepted the offer of a grant of £200 a year for seven years from Capper Pass and Son, Ltd., of Bristol. The money is to be applied to prizes for authors of papers on the metallurgy of non-ferrous extraction and on processes or plants used in the extraction or fabrication of non-ferrous metals. All papers published by the two societies will be considered for the prizes, without applications by the authors; both societies are prepared to accept papers from non-members.

The fourth Empire Mining and Metallurgical Congress is to be held in London from July 9 to 23, 1949. It will include technical sessions in Oxford and excursions based on provincial universities.

UNESCO Positions Available

Nominations are called for the following positions in the Natural Sciences Section of the UNESCO Secretariat, at the salaries indicated. The status of the positions as regards recruitment varies through several categories, according to whether a position is to be filled immediately or at a later date.

Special Technical Officer for the Exchange of Persons and the History of Science; $4910.

Technical Assistant in Scientific Documentation; with knowledge of English, French and German and experience in research or in scientific publicity; $3970.

Technical Assistant in Pure Science; with English and French and experience in research or teaching; $3970.

Programme Specialist in Engineering Science; with English, French and German and a doctorate or professorship; $6700.

Technical Assistant in Scientific Reconstruction; with English and French and experience in research or in scientific instrument manufacture or in scientific instrument sales organization; $3970.

Principal Field Scientific Officers (four) in Latin America, Middle East, South Asia and East Asia; with doctorate or professorship and many years' experience in the pure, biological, engineering or agricultural sciences and responsible experience in scientific liaison work for some years: prepared for inconveniences while travelling on tour; $6700.

Field Scientific Officers, as above; with some experience in pure, biological, engineering or agricultural sciences and ability to stimulate and co-ordinate exchanges of information from all types of scientific workers; $5450.

Technical Assistant to the Chief of Field Scientific Operations; with knowledge of languages and a thorough training in scientific method; $3570 to $3970.

Further information may be obtained from the Director, Commonwealth Office of Education, Grace Building, York Street (G.P.O. Box 3879), Sydney.

The Night Sky in January and February

New Moon occurs at January 29d. 12h. 42m. and February 28d. 06h. 55m.; Full Moon at January 15d. 07h. 59m. and February 13d. 19h. 08m., Eastern Australian Time. The Earth is in perihelion on January 3. Mercury is an evening star in early January, with magnitude −0·7; it reaches its greatest elongation on January 18; it passes the sun on February 2 to become a morning star, reaching its greatest elongation on February 28. Venus is a morning star, rising nearly two hours before the sun at the beginning of the year. Mars is about an hour behind the sun; Jupiter is in con-

junction with the sun on January 1, to become a morning star later; Saturn is in the constellation Leo and is seen in the north-east before midnight; it is in opposition to the sun on February 21.

There is a close conjunction between Mercury and Mars on January 8 during daylight and a very close conjunction (0·02 degrees) between Venus and Jupiter on January 26 at 6 p.m. E.A.T.

A partial eclipse of the sun, visible in Antarctica, New Zealand and Eastern Australia, will occur on 22 October, 1949. It will commence at about 5 a.m. by Central Australian Time and at about 7 a.m. by New Zealand Time.

The Scientific Societies

Royal Society of New South Wales.

October: C. M. Harris, Coordination compounds of copper—Complex copper (II) cuprates (1).
P. M. Stubbin and D. P. Mellor, Magnetic properties of some tungsten bronzes.
Noel Hush, Disproportionation equilibria in alkaline earth ions.
F. N. Hanlon, Geology of the north-west coal field, N.S.W.—IV, the Gunnedah-Curlewis district; V, The Breeza District; VI, The south-western part of County Nandewar.
Discussion, The education of a scientist.

November: G. K. Hughes and E. O. P. Thompson, Synthetic sex hormones.
J. A. Dulhunty, Some effects of compression on the physical properties of low-rank coal.
Commemorative addresses: Professor Harvey Sutton, The Public Health Acts of Venice, 1548, and England, 1848; J. B. Thornton, Berzelius, 1848; H. H. Thorne, Simon Stevin, 1548.

Royal Society of Victoria.

October: J. T. Jutson, The shore platforms of Point Lonsdale.
S. M. Wadham (lecture), Some aspects of the world food problem.

November: W. O. Williamson (lecture), The scientific background to ceramics.

Royal Society of Western Australia.

September: C. B. Palmer (lecture), Genetics in forestry.
Crosbie Morrison (lecture), Escape to reality—a new approach to nature study.

Medical Sciences Club of South Australia.

October: J. C. M. Fornachon, The metabolism of acetaldehyde by yeasts.
Erica Page, The preparation, standardization and use of B.C.G. vaccine in humans.
Dawn Allen, Report on attempts to preserve B.C.G. vaccine.

November: I. Jarrett, Carbohydrate metabolism in the young ruminant.
R. J. Best, Recent advances in the study of viruses.

Victorian Society of Pathology and Experimental Medicine.

October: S. Fisher, The red cell receptor for Pertussis Hæmagglutinin.
J. W. Legge, Biochemistry of macromolecular particles in Cytoplasm.
P. Woodruff, Microculture of tubercle bacilli—a rapid method for determining drug sensitivity.
E. Clarke, The indications for the use of streptomycin in pulmonary tuberculosis, its effect and limitations.
H. F. Bettinger, Pathological demonstration of adenosarcoma of the breast.

Royal Society of Queensland.

September: C. T. White, The genus *Embothrium* Forst (Family Protaceae in Australia).
K. E. Schedl, New species and new records of Australian Scolyptidae.
I. S. R. Munro, The rare Gempylid fish, Lepidocydium flavo-brunneum.
S. T. Blake, Notes on Australian Cyperaceae, VIII.
T. E. Hunt and H. M. R. Rupp, Review of Genus Bulbophyllum in Australia.
B. Boivin, Westringia—an Australian Genus of Labiatae.

Linnean Society of New South Wales.

November: June Lascelles, Studies on formic hydrogenlyase in washed suspensions of *Escherichia coli*.
F. M. V. Hackney, Studies in the metabolism of apples—VII, A study of the polyphenolase system in apples.
F. M. V. Hackney, Studies in the metabolism of apples—VIII, Ascorbic acid oxidase in apples.

Australian Chemical Institute.

The following have been elected for the year commencing September, 1948. *President* Sir David Rivett, K.C.M.G., M.A., F.R.S., F.A.C.I.; *Vice-President*, H. C. Urquhart; *Treasurer*, G. Junck; *Secretary*, H. W. Strong; *Councillors*, H. E. Dadswell, Victoria; R. R. Garran, South Australia; G. E. Rock, Western Australia; L. W. Weickhardt, N.S.W.; J. W. C. Wyett, Tasmania.

New South Wales Branch: L. W. Weickhardt, President; M. B. Walters, Secretary. Queensland Branch: H. C. Urquhart, President; J. R. Hinchley, Secretary; South Australian Branch: R. R. Garran, President; S. R. Worthley, Secretary. Tasmanian Branch: J. W. C. Wyett, President; E. W. Little, Secretary. Victorian Branch: H. E. Dadswell, President; J. L. Knight, Secretary. Western Australian Branch: G. E. Rock, President; F. W. Steel, Secretary.

Book Notices

APPLICATION OF ELECTRO-OSMOSIS TO PRACTICAL PROBLEMS IN FOUNDATIONS AND EARTHWORKS. D.S.I.R., Building Research Technical Paper No. 30. By L. Casagrande. (London: H.M.S.O., 1947. 16 pp., 27 text figs., 6″ × 9½″, paper covers.) English price, 9*d*.

See news paragraph, "Electrical Drainage of Soils". This JOURNAL, *10*, 1947, 110-111.

AUSTRALIAN HERBARIUM NEWS. No. 2, March, 1948. Published half-yearly by the Systematic Botany Committee of Section M of the A. and N.Z. Association for the Advancement of Science. (34 pp., quarto, typescript, paper covers.)

The first issue of this publication was reviewed in This JOURNAL, *10*, 1948, 121. William Hartley of the C.S.I.R. Division of Plant Industry contributes an article on Nomenclature of Naturalized Plants, after consideration of a *Check List* published by the British Ecological Society. S. T. Blake of the Queensland Herbarium writes on the *Graminae* in the second edition of Engle and Prantl's *Die Naturlichen Pflanzenfamilien*. J. B. Cleland of the University of Adelaide reviews handbooks of the flora and fauna of South Australia. There is a Note by C. M. Eardley on the consultation of Russian floras.

An annotated list is given of members of the staffs of Australian herbaria. Six pages are given

to news and notes on current work; two pages to personal notes; seven pages to a list of recent publications of interest.

FUNDAMENTAL PRINCIPLES OF IONOSPHERIC TRANSMISSION. D.S.I.R. and Admiralty. Inter-Service Ionosphere Bureau, Radio Research Special Report No. 17. (London: H.M.S.O., 1948. 82 pp., 69 text figs., 6″ × 9½″, paper covers.) English price, 1*s.* 6*d.*

During the war it was found necessary to prepare and issue a booklet to services operating short wave communications, relating their instructions for procedure to the conditions in the ionosphere. This booklet, first compiled in 1943, is now issued with only slight modification for the benefit of radio technical workers and students. The text is of a descriptive theoretical nature, but uses a minimum of mathematics. Explanation is restricted to the approximate-ray method of description. The account reaches the stage of including the effects of the earth's curvature and magnetic field; double refraction; the gyro-frequency; separation of the ordinary and extraordinary waves and characteristic polarization; absorption. The final section studies the mechanisms by which the ionosphere is formed, maintained and varied.

NATIONAL BUILDING RESEARCH INSTITUTE, South African C.S.I.R., Bulletin No. 1. (Pretoria: 1948. 43 pp., 7½″ × 9½″, paper covers.)

The National Building Research Institute originated in 1942 and was taken over and reformed by the C.S.I.R. when that body was established in South Africa in 1946. It comprises Divisions of Architecture, Functional Efficiency and Engineering. Its Bulletins, of which this is the first issue, are to contain reviews of current investigations, with abridged accounts of reports of work published separately. The present Bulletin contains short articles on cracking in buildings associated with expansive mortar in brickwork; heat interchange between a roof and its surroundings; rational theory of small foundations; foundation bearing tests and their interpretation.

IMPROVING SUPERVISION. By F. Cushman and R. W. Cushman. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, 1947. 232 pp., 5″ × 7½″.) Price, $2.50.

Intended primarily for the use of foremen and supervisors, with the point of view that supervisors at all levels are a part of management. Principal attention is given to matters associated with human relationships.

FORECASTING FOR PROFIT. By W. Wright. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, 1947. 173 pp. 8½″ × 5½″.) Price, $2.75.

The relation of economic theory and research to business enterprise; the service of the professional economist to the business executive.

COST ACCOUNTING. By C. F. Schlatter. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, 1947. 699 pp. 6″ × 9″.) Price. $6.00.

Stresses principles rather than procedures, with the view that the chief function of this branch of accountancy is the control of cost.

INDUSTRIAL MANAGEMENT. By W. R. Spriegel and R. H. Lansburgh. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall. 1947. 656 pp., numerous illustrations.) Price, $5.00.

The fourth edition of a book published by Professor Lansburgh in 1923; intended for the college student with little industrial experience. The general philosophy of the writers is based on belief in individual initiative and responsibility; mutual faith between management and employee; responsibility to the community. Sufficient technical details are included, with illustrations from a variety of industries, and account is taken of external social influences.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

On the Structure of the Electric Double Layer at a Polarized Electrode

The present note is an attempt to elucidate the structure of the electric double layer by the integration of the Debye-Hueckel equations (Debye and Hueckel, 1923).

Given a polarized electrode under an externally impressed Laplacian field $E = -\nabla V$, a concentration of n_1 cations and of n_2 anions per cc. at an arbitrary point near the electrode and a uni-univalent electrolyte of bulk concentration of aN_0 ions per cc., N_0 being Avogadro's Number, then Debye's "Grundgleichung":

$$\rho_0 \frac{\partial n_i}{\partial t} = \mathrm{div}[kT\nabla n_i - n_i\bar{K}] \quad \ldots\ldots\ldots\ (1)$$

will hold for both anions and cations. In eqn. (1), ρ_0 represents the friction constant of the *i*th particle species and K an external force acting on the *i*th particles. In the present case of ions carrying a charge e_i

$$\bar{K} = e_i\bar{E} + e_i\nabla\psi \quad \ldots\ldots\ldots\ (2)$$

The first term arises from the external field and the second from the interionic forces due to the interionic potential ψ.

At a polarized electrode $\partial n_i/\partial t = 0$, since no current flows. Within an "active space" in the vicinity of the electrode, where free charges exist, the Poisson equation will hold:

$$\nabla^2\psi = -\frac{4\pi}{D}\Sigma n_i e_i \quad \ldots\ldots\ldots\ (3)$$

D being the dielectric constant of the medium.

In a uni-univalent electrolyte the cationic charge is equal and opposite in sign to the anionic charge. Considering two plane parallel electrodes of indefinite size, the Debye equation for the average local concentrations n_1 and n_2 at a variable distance x from the cathode becomes:

$$\frac{d}{dx}\left[kT\left(\frac{dn_1}{dx}\right) + n_1 e\left(E - \frac{d\psi}{dx}\right)\right] = 0 \quad \ldots (4a)$$

and

$$\frac{d}{dx}\left[kT\left(\frac{dn_2}{dx}\right) - n_2 e\left(E - \frac{d\psi}{dx}\right)\right] = 0 \quad \ldots (4b)$$

The Poisson equation assumes the form

$$\frac{d^2\psi}{dx^2} = -\frac{4\pi e}{D}(n_1 - n_2) \quad \ldots\ldots\ldots\ (5)$$

Integrating eqns. (4*a*), (4*b*) and (5) under the boundary conditions that in the bulk of the solution

$$n_1 = n_2 = aN_0,\quad \frac{dn_1}{dx} = \frac{dn_2}{dx} = 0,\quad \frac{d\psi}{dx} = 0 \quad \ldots (6)$$

we obtain

$$n_1^{-2}\left(\frac{dn_1}{dx}\right)^2 = \frac{2}{kT}\left[\frac{4\pi e^2 n_1}{D} - \frac{1}{n_1}\left(\frac{aN_0 e^2 E^2}{kT} - \frac{4\pi e^2 a^2 N^2_0}{D}\right) + \frac{2a^2 e^2 E^2}{kT} N_0^2/n_1^2\right] - \frac{2e^2}{kT}\left(\frac{E^2}{kT} + \frac{8\pi a N_0}{D}\right) \quad \ldots\ldots (7)$$

which can be written in the form

$$M\left(\frac{dn_1}{dx}\right)^2 = 4n_1^3 - g_2 n_1 - g_3 \quad \ldots\ldots (8)$$

Equation (8) can be solved in terms of the Weierstrassian function $y = \rho(x)$ if the roots of the polynomial in eqn. (8) are known. This requires the solution of the equation

$$4n_1^3 - \left(\frac{DE^2}{\pi kT} + 8aN_0\right)n_1^2 - \left(\frac{E^2 DaN_0}{\pi kT} - 4a^2 N_0^2\right)n_1 + \frac{2E^2 Da^2 N^2_0}{\pi kT} = 0 \quad \ldots\ldots (9)$$

Evaluation of the invariants g_2 and g_3 numerically shows that for any practically realizable field E the terms involving aN_0 are many orders of magnitude larger than the terms involving E. The latter therefore can be neglected and it is then found that two of the roots of eqn. (9) coincide. In this case the doubly periodic function P(x) degenerates to $\text{ctgh}^2 x$, yielding for the local cation concentration

$$N_1 = 1/\tanh^2(\varkappa x/2) \quad \ldots\ldots (10)$$

where

$$N_1 = n_1/aN_0 \quad \ldots\ldots (11)$$

The meaning of eqn. (10) can also be expressed by stating that the activity (Hartley and Rowe, 1940) of the cations increases with $\text{ctgh}^2 x$ as the cathode is approached. However, in view of the approximation involved in neglecting E in the solution of eqn. (9) a 'fine-structure' of the electric double layer is to be expected, consisting of periodic variations in the mean local concentration of cations around the values given by eqn. (10). This is a consequence of the periodic nature of P(x), which results in a periodic correction term, of very small but finite amplitude, which is additional to the approximate solution given in eqn. (10).

Similarly for the local anion concentration N_2

$$N_2 = N_1 - 4\frac{\cosh \varkappa x}{\sinh^2 \varkappa x} \quad \ldots\ldots (12)$$

where

$$N_2 = n_2/aN_0 \quad \ldots\ldots (13)$$

The parameter $\varkappa$ appearing above is identical with the reciprocal of the Debye length (or thickness of the ionic atmosphere). It is given by

$$\varkappa^2 = 8\pi e^2 aN_0/kTD \quad \ldots\ldots (14)$$

Eqns. (10) and (12) in N_1 and N_2 are plotted against $\varkappa x$ in Fig. 1.

The kinks appearing in the graph of N_2 will be discussed in another, more comprehensive paper.

The charge density ρ follows from combining eqns. (10) and (12) as

$$\rho = 4aN_0 e\frac{\cosh \varkappa x}{\sinh^2 \varkappa x} \quad \ldots\ldots (15)$$

In order to evaluate ψ, eqns. (5) and (15) are combined to yield

$$\frac{d^2\psi}{dx^2} = -\frac{16aN_0}{D}\frac{\cosh \varkappa x}{\sinh^2 \varkappa x} \quad \ldots\ldots (16)$$

For the solution of eqn. (16) two boundary conditions are required. One is given in eqn. (6). For the second boundary condition it is assumed that

$$\psi = \psi_0 = 0 \text{ for } x = 1/\varkappa \quad \ldots\ldots (17)$$

This appears to be a reasonable assumption because it means that at the limit of the Debye ionic atmosphere the potential due to the central ion has decayed to zero. Eqn. (16) can then be integrated to yield

$$\psi = -\frac{2kT}{e}\log_e \frac{\tanh 1/2}{\tanh \varkappa x/2} \quad \ldots\ldots (18)$$

With the aid of eqn. (10), ψ can be expressed as

$$\psi_0 - \psi = kT/e \log_e N_1 \quad \ldots\ldots (19)$$

It follows that the ionic potential is merely the thermodynamic potential due to the increased activity of the cations near the electrode and the system behaves as a concentration cell. Moreover in view of the 'fine-structure' of N_1 also the mean local potential exhibits periodic fluctuations around the value given in eqns. (18) and (19).

The total potential φ at any point x in the solution then appears as the sum of ψ and the potential due to the impressed field E:

$$\varphi = \psi + E\,x \quad \ldots\ldots (20)$$

A curve relating φ and $\varkappa x$ for E = 0·1 volts per cm. is also shown in Fig. 1.

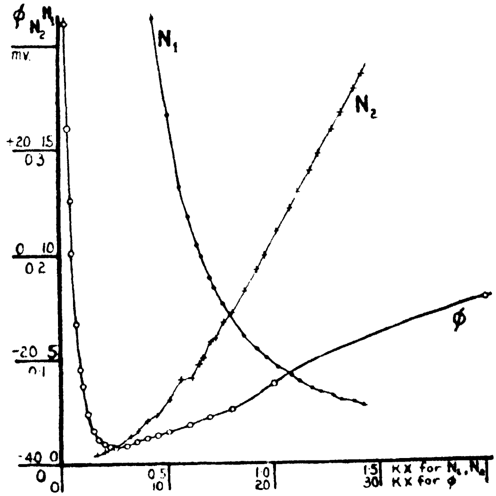

Figure 1.

In view of the degeneracy of $P(\varkappa x)$ for all practical values of E, the shape of the curves given in Fig. 1 is independent of the impressed potential. These curves, however, yield no information as to how closely the ions, on the average, may approach the electrode. That such a definite distance must exist follows from integration of eqn. (15). The total charge Q in the double layer can be expressed as $\int \rho dv$, where the integration has to be extended over all the space containing free charges. If eqn. (15) is integrated between the limits 0 and ∞, Q becomes infinite. As, however, Q must remain finite, it is not permissible to extend the integration right up to the surface of the electrode, but only to a finite distance of closest approach, x_1. This yields

$$Q = \frac{-4eaN_0}{\sinh \varkappa x_1} \quad \ldots\ldots (21)$$

x_1 will be a function of E. The externally applied potential merely alters x_1 and thereby shifts its position along the curves given in Fig. 1. Once x_1 reaches a certain critical value, x_0, the discharge commences. The critical distance of closest approach, x_0, therefore can be identified with the width of the potential barrier at the surface of the electrode.

It can be calculated from the discharge potential E_0 with the aid of eqn. (18), which then becomes

$$\frac{E_0}{2kT/e} = \log_e \frac{\tanh 1/2}{\tanh \varkappa x_0/2} \quad \ldots\ldots\ldots\ldots \quad (22)$$

As expected, x_0 varies, *inter alia*, with the valency, as can be seen from the following values:

Ion Species		E_0 vers. Electro-capillary zero	x_0
Tl^+	..	$-0{\cdot}116$ v	$0{\cdot}78 \,.\, 1/\varkappa$
Cd^{++}	..	$-0{\cdot}182$ v	$0{\cdot}22 \,.\, 1/\varkappa$
In^{+++}	..	$-0{\cdot}120$ v	$0{\cdot}21 \,.\, 1/\varkappa$

Up to the commencement of discharge, i.e. as long as $x_1 < x_0$, the process is perfectly reversible, as is also illustrated by eqn. (19). Therefore, the polarization process should be, at least partially, reversible. That this is so has been shown in a recent experimental investigation by Newbery (1947).

A full account of the present work will be published elsewhere.

One of us (F.G.) wishes to acknowledge his indebtedness to the University of Sydney for a Commonwealth Research Fellowship.

B. Breyer.
F. Gutmann.

Physico-Chemical Laboratory,
Faculty of Agriculture,
The University of Sydney.
20 August, 1948.

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Debye, P., and Hueckel, E. (1923): *Phys. Z.*, *24*, 307.
Hartley, G. S., and Roe, J. W. (1940): *Trans. Faraday Soc.*, *36*, 102.
Newbery, E. (1947): *Trans. Faraday Soc.*, *43*, 127.

Oil Isolate from Eucalyptus Dives

In a recent publication the writer (Ralph, 1947) described an isolate from the oil of Eucalyptus dives (type) as p-menthane-1:2:3-triol; a subsequent analysis for carbon and hydrogen, however, shows that this formulation is inaccurate. The new determinations, carried out by Mlle. D. Hohl in the laboratories of M.M. Givaudan et Cie, Vernier, in Geneva, with the co-operation of Dr. Y.-R. Naves, were as follows: C% 70·6, 70·8, 70·7; H% 10·7, 10·7, 10·5; proving that the material must have the composition $C_{10}H_{18}O_2$. A discussion of the work with Dr. A. Blumann initiated and confirmed this analysis.

Whilst acknowledgement is made in the original publication to Miss J. Fildes for the micro-analysis it is desired to have noted now that whilst she did perform the several other analyses reported, this particular result was returned by another operator.

C. Ralph.

Sydney,
30 September, 1948.

Reference.

Ralph, C. (1947): *J. Roy. Soc. N.S.W.*, *80*, 208.

The Pharmacology of Monacrine

The Fate of Injected Monacrine.—The injection of monacrine hydrochloride intravenously into dogs shows that thirty seconds after the completion of the injection most of the monacrine has left the vascular system and in the next five minutes the concentration falls rapidly. It can be calculated that only 5-20% of the monacrine is in the whole body water. After twenty to thirty minutes the amount in the plasma is barely detectable. The doses given varied from 0·25 to 88mg. per kg. The urinary output after thirty minutes was negligible, although even in this time some breakdown products had appeared. Using monacrine base, similar results were obtained. Preliminary assays of the various tissues indicate that most of the drug is absorbed by the muscle, although it appears also in liver, brain and kidney.

The Analeptic Activity.—During the above experiments, which were done under morphine and chloroform anæsthesia, it was noticed that when the monacrine was injected the respiration was stimulated and that in most cases the dogs were roused from unconsciousness. Accordingly, the analeptic (awakening) activity of monacrine towards morphine was investigated. Dogs were given 10-15 mg. per kg. of morphine subcutaneously: this usually produced a deep coma which would persist for some hours. After about an hour the animals were given 5 mg per kg. of monacrine intravenously. With in a minute the respiratory rate had doubled, followed by signs of activity such as twitching of the ears. The dog then gradually roused itself and within ten minutes was running round the room—in one case, actually snapping at the operator. The animals exhibited marked restlessness for a period of hours, but in no case (out of six experiments) was there a return to unconsciousness or even drowsiness. The dogs were normal after twenty-four hours and remained apparently healthy for at least a week (when they were destroyed). The same dose of monacrine alone was without any noticeable effect other than an immediate defæcation.

In the case of rabbits, this analeptic action is masked by the convulsant action of the morphine itself. However, the intravenous injection of monacrine abolishes the mydriatic action of the morphine, although this is not observed with the local application of monacrine. Work is proceeding to determine:

(a) the interaction of morphine and monacrine on the respiratory centre; (b) whether other acridine derivatives possess this action in a more marked degree.

PATRICIA P. KEOGH,
GEOFFREY A. BENTLEY.
Department of Physiology,
University of Melbourne.
17 September, 1948.

Reviews

Agriculture

THE GRASSLANDS OF LATIN AMERICA. By G. M. Roseveare. (Commonwealth Bureau of Pastures and Field Crops, Bulletin 36, 1948, 291 pp.) Obtainable from C.A.B. Liaison Officer, 314 Albert Street, East Melbourne, C.2., and from Technical Book Shops. Price, 25s.

It is difficult in a short review to do justice to a publication which, within the compass of 291 pages, brings together in a readily available form information culled from about 800 listed references, nearly all of which are in Spanish or Portuguese. It is no small achievement to have summarized these papers in the English language, especially as it has been done without loss of detail where this appeared to be of value; indeed, the Bulletin includes valuable information on the botanical composition of pastures in Argentina which has not been published elsewhere.

The contents include chapters on the natural grasslands, classified slightly arbitrarily as good, cool mountain, semi-arid, and hot savannahs, with an interesting contribution by Professor Parodi on the pastures of Corrientes and the Chaco region of Argentina. Further chapters deal with the temporary ley, classified lists of brouse and poison plants, soil conservation, animal and plant health, management and improvement, while there are also interesting accounts of the botanical and agrostological research in progress in the several countries.

It is not always easy to form a clear impression of the relative importance of various species in the pastures: indeed the detailed index of genera and species includes no reference at all to *Desmodium canum*, which is undoubtedly the most abundant and widespread pasture legume in north-eastern Argentina, southern Paraguay and much of southern Brazil. Some confusion is also caused by the inclusion of the same species and even genera under different synonyms.

Most of these defects, however, result from gaps in the published information available, for the reason that experimental pasture research, as distinct from systematic and vegetation studies, is as yet carried out on a very small scale in Latin America. To have attempted to present a simple balanced account would, as pointed out by Dr. R. O. Whyte in his foreword, have involved the sacrifice of much material which will be found of great value by all those who use the Bulletin as a reference book and literature guide. The Bulletin is adequately illustrated but the binding is hardly up to the standard of the contents.

W. HARTLEY.

Applied Science

SCIENCE AT WAR. By J. G. Crowther and R. Whiddington, C.B.E., F.R.S. (London: His Majesty's Stationery Office, D.S.I.R. publ., 1947. 185 pp., 50 photographic plates, 51 text figs. 8½" × 5½", paper covers.) English price, 2s. 6d.

Although science has played some part in many wars, in none was the part ever greater than in the war recently concluded. The purpose of this book is "to make available to the public an authoritative account of some of the more important aspects of the scientific contribution to the war effort based on official archives but so written as to be acceptable to the reader without special scientific education". The word "special" may be taken to refer to the fields of science covered in this book. The majority of laymen, including those with a general interest in science, will almost certainly find some parts of this book, at least, fairly heavy going.

As might be expected, much attention is given to the story of radar and the result is the best general account of the subject known to this reviewer. It is not only clearly and interestingly written but it is profusely illustrated with line diagrams and photographs. The history of radar in its prewar days is not the least interesting part of the story. We learn that "the first Air Exercise in connexion with radio-location was held in September, 1936. The observers watched aircraft performing exercises over the North Sea . . . They even detected aircraft slipping off to a nearby aerodrome for an early cup of tea, under the impression that their temporary absence from the sky was not noticed."

The authors have applied themselves most conscientiously to the difficult task of expounding radar to the non-specialist—even to the extent of giving the elementary theory of the action of radio valves. When it comes to explaining the action of the early magnetron, however, understandably they give up. Though some of it will call for close and careful reading, the whole chapter is a satisfying account of the successful part played by radar, not only in the defence of Britain but in the final offensive that brought victory.

This chapter is followed by others devoted to Operational Research; Science and the Sea (which includes the story of the magnetic mine and the great courage of the men who first examined enemy mines of this type); and

last, but not least, an account of the British contribution to the development of the atom bomb. In the reviewer's opinion, this chapter is one of the best in the book. Especially memorable is the miniature pen portrait of the late Lord Rutherford.

The book is well produced and is splendid value for the money. It can be confidently commended to all who wish to learn how science helped brave men win the battles of World War II.

D. P. MELLOR.

Astronomy

PRACTICAL ASTRONOMY. By G. M. Hosmer and J. M. Robbins. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 355 pp., 93 text figs., 5 star maps, 22 tables. $5\frac{1}{2}'' \times 8\frac{1}{2}''$.) Price, $4.50.

A classical American text-book upon field astronomy for engineers was written by the late Professor Hosmer in 1910; this has now been revised and rewritten, to make a fourth edition, by James M. Robbins, who is Associate Professor in Civil Engineering at the Newark College of Engineering. The book is in two parts, of which the first gives an extensive treatment of elementary principles and the second deals with the three observations of engineering astronomy. It is intended for the student "who can devote little time to the subject" and "who is interested chiefly in obtaining results". It is thus not an ideal basic text for an Australian university in which the aim, however incompletely attained, is to train the student to appreciate and tackle a problem rather than to manufacture a result.

Descriptions of the marine sextant and bubble sextant are included, but the book is written for the American "transit", which is not as accurate an instrument as the English or Australian engineer's theodolite. Theory is therefore not quite as extensive as for customary Australian field practice. To meet American practice, the solar attachment is described, in several makes.

The less-used forms of each observation have been omitted, so as not to bewilder the student. Latitude is found only by altitudes on or near the meridian; time is found only by meridian transits or by extrameridian altitudes. Azimuth is found by Polaris or by extra-meridian altitudes of the sun: the method of timed observations is given for stars at elongation and for the general extrameridian case, also for the sun near noon; but the common Australian method of extrameridian star altitudes is omitted, doubtless because of the lower accuracy of the American field instrument. The authors deal briefly with the shape of the earth, convergence of meridians and map grid projection tables.

The position-line method, which has become popular in recent years, is not mentioned. Azimuth determination by equal-altitude sun observation is recommended as a practical method, but there is no mention of the advantages of the twin-star equal-altitude method, although this is fully described in a standard surveying text of which Hosmer is co-author. It seems a pity that a book which is likely to be a standard for the civil engineer and surveyor should not take the opportunity of stimulating and partly satisfying the student's curiosity as to less utilitarian aspects of a fascinating subject, to say nothing of his sense of wonder at the objects which he is observing. Some account is included, however, of the historical development of timekeepers and of early methods for longitude. More references, to encourage and help the student to wider reading, would be welcome.

Although the fundamental problems to be solved are not clearly classified and set out in terms of geometry, there is a partial treatment of the question of choice of star position in regard to best shape of triangle. Exception must be taken to the statement on page 227, with regard to determination of time from altitude, that "theoretically a star having declination zero, observed when on the prime vertical, would be most suitable . . . . Equatorial stars should be observed when far enough from the prime vertical to have sufficient altitude". The point is not made that the error concerned is the same for *all* stars on the prime vertical, and less there than in *any* other position—in fact, the text as quoted above would give the reviewer a contrary impression.

The book is well printed in large type, well set out, and amply supplied with worked examples and with many problems for solution. It should form a convenient reference book in field practice.

R. L. ASTON.

PRACTICAL ASTRONOMY. By J. J. Nassau. (New York: McGraw Hill, 1948. 311 pp., 119 text figs., 4 star maps, 22 tables. $6'' \times 9''$.) Price, $5.00.

This is a second edition of a book first published in 1932, intended for students in civil engineering who have had no other course in astronomy and for other students who wish to do some observational work. Jason John Nassau is Professor of Astronomy in the Case Institute of Technology. The book is in two parts, of which the first covers equipment and methods used in America by the engineering surveyor, and the second leads the student on to some knowledge of those of the geodetic surveyor. Methods described in the first part are intended to conform to the accuracy of the American engineer's "transit" theodolite; the various sextants and the solar attachment are also described. The second part includes reduction of and from mean place; the micrometer theodolite; the transit instrument; the zenith telescope; the sixty-degree astrolabe.

The first part is written with a view to the American *Nautical Almanac* as the source of

data. As this gives Greenwich Hour Angle in extended tables for the principal stars, advantage is taken to lead the student through the subject without use of the concept of sidereal time. Sections offering sidereal time as an alternative method are interpolated at appropriate points, but are marked so that they may be omitted, if desired, without loss of continuity. Detail is given only of the few essential methods of observation—time by extrameridian altitude; latitude by culmination and circummeridian altitudes, and by extrameridian altitude-and-time; azimuth by elongation of Polaris and by extrameridian times. Other methods of observation are described quite briefly. The position-line method is given in conjunction with the astrolabe, but it is reduced by the "assumed position" method, which is customary in navigation although not the quickest logarithmic method with tables available for surveying accuracy. Throughout the book distinction is made between expressions suitable for the slide rule and calculating machine, and alternate forms suitable for logarithms: some of the standard layouts for computing are given in alternate forms for machine or for logarithms. A fuller account of the use of the computing machine in astronomy might be helpful if included in later editions.

The introductory principles are set out at sufficient length and with sufficient clarity of arrangement to give the student a good start. The author states, however, that the principal aim has been to present "fundamental ideas" rather than to include the various methods of observing, and it is on this claim that the book must to some extent be judged. When training students in any aspect of the art of measurement it is necessary to take continual pains to instil and re-instil into them the significance of the last figure (as mentioned by the author on page 98) and the need to examine the relative quantitative significance of the various factors and sources of error concerned. It is disappointing, therefore, to find such a loose statement (on page 117) as that "In the latitudes of the United States the altitude of Polaris near culmination remains *practically* unchanged for about 8 minutes"; again, to compare the statement (on page 17) that "the right ascension and declination of a star remain *practically* constant for years" with the statement (on page 161) that "the right ascensions and declinations of stars are subject to a number of small changes", one of which is as much as 50 seconds a year. (The italics are the reviewer's.) The "fundamental idea" of the essential practical process of focusing the telescope is established merely by two sentences of instruction which form a bewildering consecution (page 80): "First obtain a sharp focus of the cross wires, by pointing the telescope to the sky. The wires are properly focused when there is no relative movement between them and a distant object . . ." Nothing more.

More disturbing, however, is the attempt to offer some "fundamental ideas" of the choice of star position. Such discussions must always be unsatisfactory, and better dropped altogether, when they are incomplete because some of the sources of error are omitted. The author seems to be unfamiliar with the conditions of partial differentiation; at any rate (on page 141), when he seeks to find the error in azimuth due to an error in time, he differentiates an equation which is wrongly chosen to fit the circumstances. He is led to an equation which he puts into words: "the error . . . will have the least effect . . . when the meridian angle is 90° provided that the azimuth angle is nearly 0 or 180°"; in other words, *when the star is six hours from the meridian provided that the star is on the meridian.* Being in two complementary places at the same time, however, presents no difficulty to the author, for he immediately explains: "These two conditions are nearly fulfilled when we choose circumpolar stars and observe them near elongation"; in other words, we are nearly on the meridian and also nearly six hours away from it when we are as far away as a star ever goes.

Each chapter is amply provided with well-chosen problems, of which numerical solutions are given at the end of the book. The diagrams are well conceived and clearly produced; the text layout is most admirably designed to accentuate the main points. The occasional typographical errors, in a second edition, are not in keeping with the usual high standard of the publisher.

R. L. ASTON.

Bacteriology

GENERAL BACTERIOLOGY. By D. B. Swingle. (New York: D. van Nostrand Company Inc.; London: Macmillan and Company Ltd., 1947. 319 pp., 172 photographs and text figs. 9″ × 6″.) American price, $3.50; English price, £1 net.

This book covers superficially most aspects of general bacteriology but its limited treatment greatly reduces any potential value as a text-book. The first twelve chapters totalling 150 pages briefly introduce the micro-organisms—including the fungi but excluding the filtrable or ultramicroscopic types, which have a chapter to themselves at the end of the book. Another eight chapters touch upon food preservation, industrial microbiology, sewage disposal and bacteria in soil, air, water, milk and milk products. Immunological principles and methods form an important contribution from bacteriology to general biology, but the student is unlikely to gain this impression from the restricted presentation of immunological phenomena found in the two chapters allotted to infection and immunity.

As the author stresses in his first preface, bacteriology has emerged as a biological

science; but books such as his, though written with the best intentions, contribute little to the prestige of the subject. At the end of each chapter the questions, with their answers available parrotwise from the text, carry little value, and could be replaced with advantage by a short reading list to guide the student anxious to extend his knowledge. The book is not written in flowing style and numerous explanatory footnotes help out difficulties of expression; it contains plentiful illustrations, some of which are very good though many are not original.

NANCY ATKINSON.

Chemistry

CORROSION HANDBOOK. By H. H. Uhlig, Editor-in-Chief. (New York: John Wiley and Sons Inc.; London: Chapman and Hall Ltd. 1188 pp., numerous text-figs., tables and photographs. 9″ × 6″.) Price, $12.00.

In 1942 a Corrosion Division was organized in the Electrochemical Society. One of its first objectives was the publication of a convenient reference volume to cover the whole field of corrosion and to collect under the one cover the large amount of corrosion data spread throughout the scientific and engineering literature. *Corrosion Handbook*, produced under the sponsorship of the Electrochemical Society, is the happy fulfilment of that objective. Royalties from its sale will be used to further corrosion research.

The book consists of about 150 articles from some 100 contributors. Careful editing has welded these separate chapters into a logically arranged reference book. The Editor-in-Chief, H. H. Uhlig, is the Associate Professor of Metallurgy in charge of the Corrosion Laboratory at the Massachusetts Institute of Technology. The contributors are mainly from the Research Departments of large American industrial organizations.

A rather brief discussion of corrosion theory precedes a substantial section dealing, metal by metal, with general corrosion in air, gases and liquid media. This is followed by consideration of more specialized topics in corrosion, including the effect of mechanical factors. Two more sections deal with the subjects of high-temperature corrosion and the corresponding resistant materials.

An excellent series of tables, occupying fifty pages, record the degree of resistance to chemical attack of various materials. This section deals with twelve major groups of corrosive chemicals, and groups the resistant materials into three categories, according to their possible use for critical parts, or for non-critical parts, or their unsuitability, under the various conditions of temperature and concentration specified.

The later sections of the book give comprehensive discussions on the methods of protection against corrosion, and on corrosion tests. Throughout, an attempt has been made to report corrosion rates in a uniform method, either as "inches per year" or as "milligrams per square decimeters per day".

Corrosion Handbook is well indexed, and has a clear table of contents. It is suitably illustrated, the tables are clear, and references are carefully given. Adequate cross references are given in the text, while the systematic arrangement of material makes it easy to locate any required information. Good general information tables and a glossary add to convenience. The book should find acceptance and wide use, particularly among metallurgists and chemical engineers.

T. G. HUNTER.

Engineering

POWER SYSTEM STABILITY. Volume II: Transient Stability. By Selden B. Crary. (New York: John Wiley and Sons; London: Chapman and Hall, 1947. 329 pp., numerous text-figs. 5½″ × 8½″.) Price: $6.00.

The second volume under this title deals on a mathematical basis with the stability of power systems under sudden changes. For practical purposes the maximum angular displacement of the first transient swing of the rotor of an electric machine may be considered as a sufficient criterion. The questions of the "transient torque-angle" characteristic of a synchronous machine on direct short circuits and short circuits through a reactance are treated. The investigations are extended to a distribution system connected to an alternator, and to two-machine and multi-machine stability problems. Further chapters deal with the influence of additional generator characteristics, of generator braking resistors, of the governor, with high-speed reclosing circuit breakers and with system design applications. The questions connected with automatic control—the "dynamic stability" and "hunting"—are briefly dealt with. References are given at the end of the chapters and there is an extensive overall bibliography.

The book is to be recommended to readers who have some initial knowledge of the topic.

L. TASNY.

JET PROPULSION PROGRESS. By Leslie E. Neville and Nathaniel F. Silsbee. (New York and London: McGraw Hill. 232 pp., numerous photographs. 6″ × 9″.) Price, $3.50.

This is not a scientific or technical work. It is an historical review of the war-time development of the jet engine and the gas turbine written in terms which the layman will understand.

Dr. Hunsaker, of the Massachusetts Institute of Technology, in a foreword describes it as "a book covering international developments in the aircraft gas turbine from an American point of view". This is an excellent descrip-

tion: the "American point of view" is certainly well to the fore. This fact and the general flavour of the book are shown by some of the chapter titles: "How the Nazis Beat Us to It", "The British Were Early Too", "The A.A.F. and American Industry Pull a Miracle", "A Big Boost from Government Research", "Tough Problems Still to be Whipped".

Nevertheless, if the reader bears in mind the natural bias of the authors towards achievements in their own country, he will find this book an accurate historical record of a development which constitutes something of a revolution in aeronautics.

There is for the assistance of the layman a short glossary of technical terms. It is surprising to find the term "Mach number" described as "named after the Australian scientist Ernst Mach"! A bibliography consisting of references to articles of a "popular" nature in periodicals such as *Flight*, *Aviation* and *Interavia* is included. According to its heading, the bibliography covers only the period 1941 to 1944, but this is apparently a mistake, as it includes references as late as 1947.

M. W. WOODS.

PHOTO-ELASTICITY. Vol. 2. By Max Mark Frocht. (New York: John Wiley and Sons Inc.; London: Chapman and Hall Ltd. 505 pp., 425 figs., 1 coloured insert. Cloth. 9″ × 6″.) Price, $10.00.

This book is a companion volume to *Photo-Elasticity*, Vol. 1, by the same author, but the contents are such that it may be used independently of the previous volume. In Vol. 2 the author has introduced the clarity and simplicity of exposition characteristic of the previous volume, into two additional fields—the theory of elasticity and the numerical solution of Laplace's equation—which previously have been available only to the mathematically well-equipped. For these sections alone the book should be read by all interested in stress analysis.

The text may be considered to be divided into three parts. The first is an introduction to the theory of elasticity, the second gives the derivation of isopachic curves, whilst the last section deals with three-dimensional photo-elasticity.

In the section on elasticity, the compatability equations and stress function are first introduced. In subsequent chapters a parallel study is made of a large number of problems both mathematically and photo-elastically. The treatment is most stimulating.

In the second section, the author, after developing the various experimental methods of deriving the isopachic curves, gives an extremely satisfactory exposition of the numerical solution of Laplace's equation. This is profusely illustrated with examples although it is unfortunate that some numerical errors occur. The third section is devoted to the theory and technique of three-dimensional elasticity. Examples are given of the behaviour of circular shafts in tension and bending together with the application of photo-elastic methods to circular shafts of variable and uniform section under torsion. A feature of this section is the demonstration of the stress-optic law in three-dimensions using frozen stress patterns.

In conclusion, it may be said that this volume admirably supplements Volume 1 and should be invaluable to all workers in photo-elasticity.

C. A. M. GRAY.

Forestry

FOREST INFLUENCES. By Joseph Kittredge. (New York: McGraw Hill, 1948. 394 pp., 25 figs., 71 tables, bibliography of 381 titles. 6″ × 9″.) Price, $4.50.

The author, Professor of Forestry in the University of California, brings together an amazing amount of information on the subject of forest influences. His painstaking task is best revealed by the 381 items listed in the bibliography. Whereas most other books on forests stress the influence of climatic, topographic and human factors on forests, in this work the relationship is reversed, and the effects of forests on climate, streams, soils and topography are studied in detail.

The novelty of the subject makes it necessary to define it carefully, to deal with its scope and its relations with other subjects, and with its origins. It may come as a surprise to many that the first practical move towards fostering beneficial forest influence should date back to the year 1215, when Louis VI of France issued a decree "of waters and forests". Many other sporadic actions by governments and persons followed, but the subject was never studied as one whole until the present time. It may be said that this book breaks new ground because it presents such a vast subject as one great picture; there had been many short papers written in the past, and many of them have been extensively quoted by the author, but never before had there been any attempt at a general co-ordination on such a wide scale.

Throughout the book mathematical expression is given to most of the facts discussed. The author is well aware of the dangers of this method and warns that many equations now given will have to be altered at some future time, when more details or a more general interpretation will be available. At present one gets the impression of a picture of impressive magnitude, with many obscured or blurred fragments. This is not the author's fault: the field is so immense that hundreds of investigators were only able to deal with a small fragment each, and the picture would be misleading if the fragments were placed together without leaving the intervening gaps as they actually are. On the

whole, one of the most stimulating effects of such a course is to prompt more and more research workers to contribute additional fragments, and this is no small contribution on the part of the author.

For the scientist, the discussion of the method followed may be of great interest. The simplest method is by comparing two areas with different cover, forest on the one and smaller plants or bare soil or rock on the other. Another method consists of comparing conditions in and below the trees with conditions above them. A more radical method studies conditions in a forest area and in the same area after it has been cleared of the trees. It is obvious that each method has some drawbacks, so that a combination of the first and third methods outlined above may give the most reliable results. These methods are of interest to scientists because they involve working over a period of many years, with observations which very often have to be intermittent because of climatic, economic or other reasons, with resulting gaps and interpolations that may affect the final results.

The book studies in detail the influence of forests on solar radiation, and postulates that the effectiveness of the forest in reducing the intensity of solar radiation increases with tolerance of species and with progression of the natural succession towards the climax. As to temperatures, slight changes in the height at which thermometers are exposed may make a great difference to the records; it may be said that forests have an equating influence, reducing maxima and increasing minima, but also reducing the annual mean to a certain extent. As to wind, a good shelter-belt may reduce its speed down to 20 per cent. of the speed in the open. Reduced wind speed and lower temperatures bring forth slightly higher relative humidities. The influence of forests on rainfall seems to be very small. Each of these concise statements is fully supported by a thorough discussion of analytical data and reference to the source when space does not allow of a full discussion.

Other chapters follow, with an equally good treatment of forest influences on runoff and stream-flow, on erosion and erosion control, and especially on vegetation and erosion control.

This book will be exceedingly useful to the botanist and the geographer, as well as to the engineer and the forester. It is well produced and solidly—and soberly—bound. It is the kind of book one likes to see revised and republished every few years, as a *corpus* of knowledge for everyday use—knowledge almost impossible to get elsewhere.

J. GENTILLI.

Physics

HIGH VACUA. By Swami Jnanananda. (New York: D. van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1947. 310 pp., many text figs. $8\frac{1}{2}'' \times 5\frac{1}{2}''$.) American price, \$5.50; English price, £1 10s.

The first chapter of the book covers seventy-three pages and is devoted to relevant kinetic gas theory. This includes the flow of gases through tubes at pressures sufficiently low for the viscosity effect to be negligible. The problem of thermal efflux is treated. For a number of gases and vapours molecular data are provided which include collision frequency, mean free path length, molecular diameter, viscosity, thermal conductivity and coefficient of diffusion. The rate of evaporation and vapour pressure of tungsten is given for temperatures ranging from 2000 to 5100 degrees absolute.

The second chapter is introduced with an eight-page section on the influence of connecting tubing on the speed of exhaustion of a vessel in a high vacuum system. The remaining seventy-two pages deal with the principles, construction and performance of rotary diffusion pumps. Many of the well-known rotary types are described, including the molecular pumps designed by Gaede, Holweck and Siegbahn. Several designs of mercury and oil diffusion pumps are given. The chapter concludes with a table which gives the mouth speed and limiting pressure of a variety of pumps. The author has evidently been guided by manufacturers' claims in

recording limiting pressures. For the rotary oil pumps these claims are, in the main, extravagant. There are over fifty illustrations of pumps in this chapter. It is surprising that no reference is made to the very excellent Kinney pumps.

The author in Chapter III gives considerable information regarding the theory and performance of most of the vacuum gauges which have appeared in the literature up to 1939. This chapter extends over ninety-two pages. It is divided into sections dealing with mercury and oil filled manometers, and gauges which depend on radiometric action, gaseous thermal conductivity, electrical conductivity and viscosity. The chapter concludes with a general survey and a chart setting out the upper and lower pressure limits for fourteen gauges. The Philip's Gauge (Penning), which appeared in the literature in 1937 and which is so useful as a continuous indicator gauge in the region 10^{-4}–10^{-6} mm. of mercury, is not mentioned.

The fourth chapter of twenty-eight pages is entitled "The Technique of High Vacuum". It gives information mainly about glass-to-metal seals, the properties of a number of waxes and greases, the composition of some solders and fluxes, a note on leak detection and a number of methods of providing for slow leaks.

There is useful information in the twelve pages of Chapter V on adsorbed and occluded gases in glasses and metals, and the temperatures at which such gases are partially and almost completely removed.

The last eleven pages, which comprise Chapter VI, treat of the reduction of pressure by the use of refrigerated and outgassed charcoal, by electric discharge and by metallic getters.

The author in compiling this work has made selections from the literature up to about the year 1939. The book is logically written, very well illustrated and well authenticated. To many engaged in research which requires a knowledge of high vacuum it should prove useful. It is, however, disappointing in that (a) scarcely any references have been made to developments during the past decade; (b) too much space has been devoted to material which has already been presented in other treatises; (c) for some of the more modern instruments and techniques the treatment is not sufficiently detailed and critical.

J. BANNON.

Psychology

FOUNDATIONS OF PSYCHOLOGY. Edited by E. G. Boring, H. S. Langfeld and H. P. Weld. (New York: John Wiley and Sons; London: Chapman and Hall Ltd., 1948. 632 pages, 248 text figs. 7½" × 9½".) Price, $4.00.

This is the third form of the introductory general text edited by Boring, Langfeld and Weld. As in the previous two, the chapters have been prepared by a variety of experts (eighteen this time) in the respective fields, and then skilfully woven together by the editors. Although showing obvious affinities with the earlier forms, this is substantially a new book—larger, re-arranged and including much new material on old as well as new topics. It should prove an excellent text for a first year course for students who plan to proceed to further study of psychology. It includes almost all of the matters that most teachers of such courses would want in the text and not a great deal that they would regard as unneeded. As well as being up to date in its information, it places more emphasis on social and dynamic material than did its predecessors and this is what the contemporary teacher is likely to expect.

There appears to be only one serious defect of the policy of multi-authorship. Perhaps, in achieving integration and continuity, the editors have had to smooth away much of the real controversy that still remains in psychology. The class-room teacher whose students use the text can readily correct this; he cannot, however, be expected to correct another product of the desire to produce an authoritative text, namely, the practice of stating results of investigations without reference either to the procedures employed in them or to the bibliographical details needed to locate them. Results of many studies still open to dispute are stated as though they could be found any day and every day in the laboratory, as are the data of the more advanced natural sciences. The student must recognize that the data has not come out of the blue and may be challenged or corroborated by the very method used to obtain it.

Although its level of treatment is such that the student will need to work hard in using it, the book is clear in statement, well illustrated, and gives carefully selected supplementary reading at the same or next level of treatment.

W. M. O'NEIL.

METHODS OF PSYCHOLOGY. Edited by T. G. Andrews. (New York: John Wiley and Sons; London: Chapman and Hall Ltd. 716 pp., many text figs. 6" × 9".) Price, $5.00.

This comprehensive, if at times superficial, book arises from the recognition of the long-standing need for a book on psychological methodology. The editor and most of his twenty-one collaborators recognize that a statement of findings has little significance without a statement of the methods employed and consequently have set out to write a supplement to the standard type of textbook which contents itself with findings. Although the book has many values and will be a valuable supplement to factual texts, it does not uniformly achieve its set aim. Firstly, virtually nothing is said about the more logical aspects of methodology and what is said is not only too brief but is pitifully misleading—consider,

for instance, the editor's own section on empiricism and rationalism. Secondly, the labour is divided amongst the collaborators not in terms of areas of method but in terms of areas of fact: consequently, we find the usual chapter headings such as Learning, Memory, Thinking, Perception, Vision and so on. This inevitably leads the contributors in many cases into stating findings at the expense of more exhaustive examination of methods and into a good deal of duplication—for instance, Testing and Interviewing are dealt with at greater or less length in several chapters, in much the same terms in each case.

The net result of these basic defects is a failure to scrutinize in any thorough way the methodology of psychology. On the other hand, the book does bring within one pair of covers a clear description of most of the technical and instrumental devices used by the psychologist in his fact-finding work; and a few of the contributors, notably Buxton and Thurstone, do provide quite valuable methodological studies.

W. M. O'Neil.

Technology

Principles of Food Freezing. By W. A. Gortner, F. S. Erdman and Nancy K. Masterman. Edited by L. A. Maynard. (New York: John Wiley and Sons; London: Chapman and Hall. 281 pp., 60 text-figs. and photos. 5½" × 8½".) Price, $3.75.

During the past seventy years or so there have been a large number of detailed physical, chemical and biological studies of the freezing of foods. An excellent review of the work carried out up to the year 1922 was produced by Stiles (Food Investigation Board, Spec. Rep. No. 7), and a further review of the outstanding contributions since that time, particularly by workers at Cambridge and Karlsruhe, has long been needed.

When the editor and the authors claim that this book deals with basic principles rather than rule-of-thumb methods, one might reasonably expect, at least, a condensed review of the main contributions during the past twenty-five years. The hope is not realized in a book which, with the exception of a section on the effects of the rate of freezing, deals in only a cursory manner with the basic principles of the subject. The major contributions on the freezing of animal tissues by Moran and his colleagues at Cambridge and by Plank and Heiss at Karlsruhe are ignored: in fact, there are only six references to publications outside the North American continent.

The book is divided into three sections—the product, the consumer and his needs, the engineering of food freezing—wherein the main aspects of the preparation, freezing and storage of plant and animal foods are explained simply, but inadequately. The technological aspects seem to be written mainly for the use of owners of home freezing units and locker plants. While this publication may prove useful to such people, it cannot be recommended to serious students of the subject, for whom Tressler and Evers' *The Freezing Preservation of Foods* must remain the best general, if mainly technological, compilation.

J. R. Vickery.

Industrial Applications of Infra-Red. By James D. Hall. (New York and London: McGraw Hill. 201 pp., numerous photos. and text figs. 6" × 9".) Price, $3.50.

This book is an essentially non-technical account of the application of infra-red radiation for heating purposes and, as the author indicates in the preface, it is written for the production manager and plant supervisor. It will, therefore, be somewhat disappointing to the scientific reader, who might expect from the title some discussion of a fundamental nature of the various factors involved in infra-red heating.

The first chapter covers an elementary account of heat and heat transfer, leading to a chapter on the specific advantages of radiant heating, which are put forward without prejudice. A further chapter is devoted to the use of the incandescent filament lamp as a source of infra-red radiation, and to the precautions which must be observed in using these lamps to ensure optimum performance consistent with long life. Radiant heating equipment is described in all its possible manifestations and the design of infra-red installations is discussed in some detail. Special application involving uniform heating of awkwardly-shaped articles, surfaces of high reflectivity, glass, granular materials, textiles and finishes involving inflammable or explosive volatiles are described and methods of meeting the problems peculiar to each outlined. The more straightforward applications to industrial heating, of which the most important at present is the rapid drying of surface finishes, are described and illustrated in the last two chapters. Gas-fired infra-red generators, however, are confined to three pages of an appendix—hardly an equitable assessment of their relative importance in industry.

There is undoubtedly contained in this volume much information of value to the plant engineer who is planning the installation of infra-red heating equipment, but even so one can hardly see the justification for some 120 poor reproductions (occupying 100 pages out of 200) illustrating almost every conceivable arrangement of a battery of infra-red lamps.

This book leaves the reader with a wide, but superficial, impression of the scope of this new and exceedingly important industrial process; it does, nevertheless, have all the hallmarks of an advertising brochure raised to the status of a monograph.

A. L. G. Rees.

The Australian Journal of Science

VOL. XI 21 February, 1949 No. 4

The Foundations of Academic Freedom

MICHAEL POLANYI.*

THE analysis of the grounds on which freedom rests is of great practical interest to those who love freedom. For by clarifying these grounds we may hope to make them more secure. By raising some of the great questions concerning the nature and justification of freedom we may try to eliminate some of the ambiguities of freedom which have, particularly in our days, laid freedom open to misunderstanding, and worse, to perversion and discredit.

Freedom is ambiguous, for there are two quite different ways of being free. One way is to be free from external constraint. The rational limits to this freedom are set by the condition that it must not interfere with other people's right to the same freedom. I have, for example, freedom to choose between going to sleep or listening to the wireless so long as my listening does not interfere with my neighbour's choice between the same two alternatives. This is the approach to freedom which the great utilitarians like Bentham and Mill have impressed on our age. It is linked to the idea that the basic pursuit of a good society is the greatest happiness of its greatest number and that freedom is a condition of this pursuit. This individualist or self-assertive conception of freedom can, unfortunately, be used to justify all kind of objectionable behaviour. At some time or other it has been invoked in protection of the worst forms of exploitation, including even the keeping of slaves. It has served as the ground for the romantic movement in its exaltation of the unique, lawless individual and of nations striving for greatness at any price. Its fundamental opposition to all restraint can easily be turned into nihilism.

The other conception of freedom is in its extreme form almost the opposite of the first. It regards freedom as liberation from personal ends by submission to impersonal obligations. Its prototype is Luther facing the hostile Assembly at Worms with the words: *Hier stehe ich und kann nicht anders.* Such surrender to moral compulsion is certainly a form of liberation. But the theory of such freedom can become very much like a theory of totalitarianism. It does become altogether totalitarian if you regard the State as the supreme guardian of the public good; for it then follows that the individual is made free by surrendering completely to the State.

These discrepancies in the conception of freedom are a real danger to freedom. For even without considering the extremes either of nihilism or totalitarianism, we may well feel that the *individualist* theory of freedom is selfish or at least uninspiring, while the theory of freedom by *self-surrender* does not seem to accord with our sympathy for the individual pursuing his own happiness in his own personal manner.

Academic Freedom

It seems to me that the study of academic freedom may serve as a guide to this dilemma. For in the foundations of academic freedom we shall find the two rival aspects of liberty so firmly interwoven that their essential relationship and true balance becomes easily apparent. The study of academic freedom has at any rate the great advantage that it is fairly easy to say in this case what we mean by freedom. Academic freedom consists in the right

(*a*) to choose one's own problem for investigation;

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This article forms Occasional Pamphlet No. 6 of the Society for Freedom in Science, published in September 1947. Some minor editorial changes have been made in reprinting, with the insertion of subtitles. The address of the Editor and Assistant Secretary of the Society is the University Museum. Oxford.

(*b*) to conduct research free from any outside control; and

(*c*) to teach one's subject in the light of one's own opinions.

At first sight this kind of freedom may seem to raise difficulties for both of the two great theories of freedom. For clearly, the scholar is not given freedom primarily in order to promote his happiness; but neither is he meant merely to fulfil an obligation. While these are both true functions of freedom, some principle seems yet missing which should join the two together—a stereoscope to unite these two images of freedom; and we may find this by observing yet a third function of freedom which has hitherto been given little notice, if any, in the major philosophic discussion on freedom. A clue to this may be given by quoting a statement made by Dr. Enrico Fermi to an American Senate Committee sitting on the question of legislation in support of scientific research:

> 'Experience has indicated that the somewhat haphazard exploration of the field of knowledge that results from an intensive freedom of the individual scientific worker to choose his own subject is the only way to insure that no important line of attack is neglected.'

There is nothing uncommon in this claim, which is in fact unquestioningly assumed as true by scientists in general. Though they rarely have occasion to express it in words, they effectively endorse it by the whole practice of scientific life, and we may safely assume that it is broadly true. Let us examine a little further what it implies.

Organization through Freedom

It is claimed here that freedom is an efficient form of organization. The scientists of the world are viewed as a team setting out to explore the existing openings for discovery, and it is said that their efforts will be efficiently coördinated if only each is left to follow his own inclinations. It is claimed in fact that there is no other efficient way of organizing the team; that any attempt to coördinate their efforts by directives of a superior authority would inevitably destroy the effectiveness of their coöperation.

Now this, in a way, is surprising. For usually one thinks of coördination as a process imposing restraint on the discretionary powers of individuals. Let us try to analyse how it can be correct to claim that the opposite holds in science: optimum coördination being achieved here by releasing individual impulses.

The usual thing is of course that when a number of persons apply themselves independently to parts of the same task their efforts remain essentially uncoördinated. A party of women shelling peas represents no coördinated effort: for their total achievement is simply the sum of their individual outputs. Similarly, a team of chess players is essentially uncoördinated, for each plays his opponent according to his own lights and the performance of the team is simply the sum of the games independently won by each member.

By contrast we can see the distinctive character of science coming into view. Science is not conducted by isolated efforts like those of the chess players or shellers of peas, and science could make no progress that way. If one day all communications were cut off between scientists, that day science would practically come to a standstill. Discoveries might continue to be made during the first few years of such a regime at about the normal rate, but their flow would soon dry up and henceforth progress would become fitful and sporadic, and the continued systematic growth of science would cease entirely. The coördinative principle of science thus stands out in all its simple and obvious nature. It consists in the adjustment of each scientist's activities to the results hitherto achieved by others. In adjusting himself to the others, each scientist acts independently, yet by virtue of these several adjustments scientists keep extending together with a maximum efficiency the achievements of science as a whole. At each step a scientist will select from the results obtained by others those elements which he can best use for his own task and will thus make the best possible contribution to science. And thereby he will open the field for other scientists to make their optimum contribution in their turn—and so on indefinitely.

Self Coördination

We are faced here—it would seem—with a basic principle leading quite generally to coordination of individual activities without the intervention of any coördinating authority. It is a simple principle of logic which can be demonstrated by quite trivial examples. Suppose, for example, we had to piece together a very large jigsaw puzzle which it would take

one person several days or even weeks to put together. And imagine that there were real urgency in putting the puzzle together—that some important secret would be revealed by the solution—so that we must press for the result as fast as we can. We would no doubt engage a team of helpers; but how would we organize them? There would be no purpose in farming out a number of sets of the puzzle (which could be duplicated photographically) to several isolated collaborators and then to add up their results after a specified period. Though this method would allow the enlistment of an indefinite number of helpers, it would bear no appreciable results. The only way to get the job finished quickly would be to get as many helpers as could conveniently work at one and the same set and let them loose on it, each to follow his own initiative. Each helper would then watch the situation as it is affected by the progress made by all the others and would set himself new problems in accordance with the latest outline of the completed part of the puzzle. The tasks undertaken by each would closely dovetail into those performed by the others. And consequently the joint efforts of all would form a closely organized whole, even though each helper would follow entirely his own independent judgment.

It is also rather obvious what would happen if someone believing in the paramount effectiveness of central direction should intervene and try to improve matters by applying the methods of central administration. It is impossible to plan in advance the steps by which a jigsaw puzzle is to be put together. All that a centralized administration could achieve therefore would be to form all helpers into a hierarchical body and direct their activities henceforth from one centre. Each would then have to wait for directions from his superior and all would have to wait until a decision is taken at the supreme level. In effect all participants except the one acting as the head of the organization would cease to make any appreciable contribution to the piecing together of the puzzle. Efficiency of coöperation would fall to zero.

We can thus see confirmed here the twofold claim implied in the statement by Dr. Fermi: namely, that on the one hand the actions of individuals acting according to their own judgment may become spontaneously—and yet efficiently—coördinated to a joint task, while on the other hand subordination of the individual efforts to a central authority would destroy their coördination. Moreover, we can see clearly adumbrated the applicability of this logic to the self-coördination of scientists in the pursuit of discovery. For this logic seems to consist simply in the extension of an unknown pattern by individual steps, under the twofold condition that each suggested new step can be readily judged as to its correctness or otherwise, and that each new step is rapidly brought to the notice of all participants and taken into account by them when they make their own next step.

The Goal of Science

Is this then all that can be said about the curious claim, for which I have quoted Dr. Fermi, that the avenues of potential discovery are most effectively explored if we let scientists free to choose their own problems? Is it as simple as all that?

In a way it is. The logical basis for the spontaneous coördination of scientists in the pursuit of science is as simple as, and in fact identical with, that which operates the self-coördination of a team engaged in piecing together a jigsaw puzzle. But there is something profoundly different, and also highly significant in the way in which the elements of the same logical machinery are provided in either case. For the pieces of a jigsaw puzzle are bought in a shop with the certainty that they will yield a solution known to the manufacturer. But there is no similar assurance given to us by the Creator of our Universe that we shall find an intelligible ground-plan of it by continuing to piece together the elements of our experience.

It is not even clear in what sense science—or scholarship in general, to which all these considerations also apply—can be said to have any comprehensive task at all. The search for a 'ground-plan' of the Universe can only be meant in a vague and fluid sense. Pythagoras and even Kepler were seeking a ground-plan in terms of numerical and geometrical rules, Galileo and Newton sought it in terms of mechanism, today we are seeking it once more in terms of mathematical harmonies, but other than the number rules of Pythagoras. In the field of general scholarship even more

radical changes continue to happen in the general purpose of enquiry. Compare the moral interpretation of history by a Lord Acton or a Toynbee with the way history is interpreted by Marxists like Laski and G. D. H. Cole, or by psychoanalysts like Franz Alexander or Jung. Moreover, while in the jigsaw puzzle a new piece either fits into a particular gap or fails to fit into it in the most obvious fashion, in science this is not so. Some new discoveries may click immediately into an indisputable position, but other claims, often more important, remain uncertain for a number of years. To every step of scientific progress there is attached an element of uncertainty regarding its scope and scientific value.

It is unmistakable that the logic of self-coördination is based, in science, on elements which are much vaguer than those present in the case of a jigsaw puzzle. In science and scholarship the uncertainty of the final task and the dubitability of each single step are indeed such that this may well call in question the whole analogy which we have hitherto pursued.

The Coherence of Science

Yet in my view this is only to be taken as a warning to be careful in using this analogy. Take once more the case of science. In spite of the profound changes in general outlook and method which have occurred even in the last four hundred years of scientific development, we can see a distinct coherence of the contribution made to science during that period. Most of the scientists of that period who were highly respected in their own time are still in high regard among scientists today and few have been added to the ranks of great scientists today whose works were generally thought valueless in their own days. It is true that many of Kepler's, or even Galileo's or Newton's arguments may appear irrelevant today. And again, Galileo and Newton would probably be profoundly unsatisfied with the kind of explanation quantum mechanics gives us of atomic processes. But Galileo and Newton remain nevertheless classics of modern science. Their discoveries are the very foundations of the picture which we are forming of nature today and their methods of investigation are still among the archetypes of the modern scientific method. Their personal example is recognized with unchanging loyalty and indeed with a reverence which increases through the centuries as the realm of science, which they founded, continues to extend its domain.

This coherence of science over the centuries is paralleled by its coherence over all regions of the planet. Some energetic attempts have been made in the past fifteen years or so to make scientists in Germany believe that as Germans they must disbelieve relativity and quantum mechanics, and since 1939 great pressure has been exercised on scientists in Russia to reject Mendelism on account of its supposed incompatability with Marxism, but these objectionable efforts have happily been sporadic and mostly passing in their effects. Science is on the whole still accepted today in the same way all over the world.

Here, I believe, we have before us a sufficient logical ground for the spontaneous coördination of individual scientific discoveries. The ground is provided by such coherence as science does possess. In so far as there exists a steady underlying purpose in each step of scientific discovery and each such step can be competently judged as to its conformity to this purpose and its success in approaching it, these steps can be made to add up spontaneously to the most efficient pursuit of science. Let us expand this a little further, for it contains the essential result of our argument.

The Spiritual Reality of Science

It is not quite enough to recognize science as pursuing a consistent purpose. So did, in a way, the students of the caballa, the witch hunters and the astrologers, and we must distinguish the purpose of science from that of these erroneous pursuits. We could not speak of a true spontaneous growth of science if we considered the apparent coherence of science as a result of a series of accidents or as the expression of a persistent error. We must believe on the contrary that it represents the consistent expansion of some kind of truth. In other words, we must accept science as something real, as a spiritual reality partly disclosed at any particular moment by the past achievements of science and to be disclosed ever further by discoveries yet to come. We should regard the minds of scientists engaged in research as seeking intuitive contact with these as yet undisclosed parts of science, and look upon discovery as the result of a successful contact with a hitherto hidden spiritual

reality. Whenever a scientist wrestles with his intellectual conscience, whether to accept or reject an idea, he should be taken to be making contact with the whole tradition of science, in fact with all scientists of the past whose example he is following, all those living whose approval he is seeking and all those yet to come for whom he is proposing to lay down a new teaching. The coherence of science must be regarded as an expression of the common rootedness of scientists in the same spiritual reality. Then only can we properly understand that at every step each is pursuing a common underlying purpose and that each can sufficiently judge—in general accordance with other scientific opinion—whether his contribution is valid or not. Only then are the conditions for the spontaneous coördination of scientists properly established.

This view of the coherence of science and of the nature of science in general leads us back to the two rival aspects of freedom and allows us to combine the two.

Spontaneity and Constraint

Science, we can see now, shows strong features corresponding to both aspects of freedom. The assertion of his personal interest and personal opinion with the full force of his personal passion is the mark of the great pioneer, who is the salt of the earth in science. Originality is the principal virtue of a scientist and the revolutionary character of scientific progress is indeed proverbial. At the same time science has a most closely knit professional tradition. It rivals the Church and the legal profession in continuity of doctrine and strength of corporate spirit. Scientific rigour is as proverbial as scientific radicalism. Science fosters a maximum of originality while also imposing an exceptional degree of critical rigour.

And yet between these two aspects there is no disharmony. A clash may occasionally occur between originality of the individual and the critical opinion of his fellow-scientists, but there can be no conflict between the principles of spontaneity and constraint. There are no romantic scientists who demand the authority to express their individuality as such heedless of other scientists' opinions. No—the revolutionary in science does not claim to be heard on the grounds of any right to assert his personality against outside compulsion, but because he believes he has grounds for establishing a new universally compelling opinion. He breaks the law as it is in the name of the law as he believes it ought to be. His is an intensely personal vision of something which in his view everyone henceforth must recognize.

This unity between personal creative passion and willingness to submit to tradition and discipline is a necessary consequence of the spiritual reality of science. When the scientist's intuition seeks discovery it is reaching out for contact with a reality in which all other scientists participate with him. Therefore, his most personal acts of intuition and conscience link him most closely with the universal system and the canons of science. While the whole progress of science is due to the force of individual impulses, these impulses are not respected in science as such, but only in so far as they are dedicated to the tradition of science and are disciplined by the standards of science.

These considerations can be readily generalized to scholarship in general. Academic freedom can claim to be an efficient form of organization for discovery in all fields of systematic study controlled by a tradition of intellectual discipline.

The Constraint of Patronage

The example of the jigsaw puzzle has proved useful. It has guided us on to an effective union of the two rival aspects of freedom. Let us recall that this example also gave us a hint concerning the dangers of an outside central authority superseding the impulses of individual initiatives. We can now see more clearly how this applies to academic pursuits, and particularly to their relation to the State. If the spontaneous growth of scholarship requires that scholars be dedicated to the service of a transcendent reality, then this implies that they must be free from all *other* authority. Any intervention on the part of another authority could only destroy their contact with the aims to the pursuit of which they are pledged.

So far the position is simple and clear enough. But tolerance of academic freedom by the State is not enough today. On the modern scale institutions of higher learning and higher education can be upheld only by public subsidies, and governments do recognize today

that to give such support is a proper public responsibility. But if scholars are rewarded by the State and given by the State the means for conducting their researches, this may well bring to bear on them a pressure deflecting them from academic interests and standards. For example, a dairy-producing State, like Iowa, may dislike it if its scholars discover and make known the nutritive and economic advantages of margarine and the legislature of the State may want to intervene against its own State University to prevent it from publishing such conclusions—as actually happened in Iowa. There are many opportunities for such conflicts between the visible interests of the State and the interests of learning and truth cultivated for their own sake. How shall these conflicts be avoided?

Up to a point the problem of such conflicts is really quite simple. The fact that the King appoints and pays the judges does not affect their independence so long as the King is under the law. The King of England also appoints and pays the chief opponent of his own government in the person of the leader of the parliamentary opposition. Governmental patronage is no danger to the independence of the persons appointed so long as these are allowed to function properly. It then means merely an undertaking by the government to provide fuel and oil for a machine which the government does not itself control. In the case of legal appointments, the machine is controlled by the principles of justice as laid down by law and interpreted by the legal profession; while in the case of political appointments the King sanctions the popular will as expressed through the established electoral machinery.

These examples, particularly that of the appointment of judges by the government, are a close illustration of the way in which the State can give support to academic scholarship without affecting academic independence. It must regard an independent academic life in the same light as it regards an independent administration of justice. Its respect for *scholarship* and for the principles guiding the free advancement and dissemination of knowledge must be rooted as deeply as its respect for law and justice. Both should derive validity from similar sources; from spiritual realities, embodied in great traditions, to the service of which our civilization is dedicated.

Acceptance of Academic Opinion

But however great the respect of the State for an independent judiciary, it could not give effect to this attitude if the legal profession were profoundly divided into rival schools of thought. For the State would then have to arbitrate between these. And we find something similar holding in respect to scholarship. A government can observe fully the freedom of science in all questions on which scientific opinion has on the whole agreed. But if academic opinion were sharply divided in assessing the merits of discoveries and the abilities of scholars, then there would be no possibility of maintaining academic freedom. Suppose that when we assemble in committee to elect a new professor, we would have no accepted leaders of scholarship to turn to for consultation, and no accepted standards of scholarship by which to judge candidates ourselves, then chairs would have to be filled by the light of other than academic considerations; the next best thing being probably to please popular opinion or the government in power. A strong and homogeneous academic opinion, deriving its coherence from its deep common rootedness in the same scholarly tradition, is an indispensable safeguard of academic freedom. If there exists such an academic opinion, and if public opinion at large respects academic opinion, then there is no danger to academic freedom. Then it matters little to academic freedom whether the universities get their money from public or private sources.

A survey of the universities in various countries shows a great variety of machinery for making academic appointments. But I can find very little connexion between the nature of these constitutions and the strength of academic freedom established under their dominion. In some Continental countries—e.g., Holland, Belgium, Sweden, Norway, Denmark, Switzerland—State-run universities have been a complete success; whereas in some States of America, for example, they have been repeatedly impaired by an intolerant legislature. The difference lies entirely in the condition of public opinion, which has shown a greater respect for the autonomy of scholarship, say, in the canton of Zürich than in the

State of Iowa. Nor is self-government of universities a safeguard against corruption of academic freedom. It has happened that universities were run for a generation by a clique of professors keeping up a close system of nepotism and political patronage. Any candidate who had acquired a scientific reputation was regarded as a seeker of publicity who was trying to force himself on the university by unfair practices. Institutional safeguards of academic freedom are desirable, but we must not forget that they are not enough and may even become the shield of a corrupt academic opinion.

Reliance Upon the Individual

Among the desirable constitutional safeguards I should like particularly to mention the custom of permanent academic appointments. Appointment for life or until the age of retirement grants a high degree of independence to the scholar, as it does to the judge and to the minister of religion. The case of the permanently appointed scholar is, however, somewhat peculiar. For in contrast to the judge and the minister, his obligations are not even remotely laid down by any explicit rule. His duties as teacher and administrator must be so apportioned as to leave him free to devote his principal energies to creative work. There is no way of assuring that a man so appointed will go on doing such work. The only thing you can rely on is his love for his work and on the prospect that his love will last. You cannot even hope that love may be successfully replaced by duty, as it may perhaps be in marriage. For no one can make discoveries prompted mainly by a sense of duty. He needs to be urged on by a creative passion. We can see here how completely the personal aspect of freedom—namely, liberty to assert oneself—coincides in the field of scholarship with the social aspect, of surrender to the service of a higher purpose.

Applied Research

We may like to test these principles further by applying them to some questions of detail. We may turn for example to the difference, which at first sight may appear puzzling, between the independent standing claimed here for members of the academic profession and the admittedly subordinate condition of well-trained scientists engaged in pursuits such as the various forms of surveying and of scholars employed as bibliographers and the like. This difference finds its ready justification in the distinction between creative and routine work. We may recall the example of the jigsaw puzzle. The helpers are granted individual liberty because they have to guess their way at each step. To guess the solution to a problem offered by nature—as is demanded of the scientist—requires the exercise of intuitive faculties controlled by an intellectual conscience. They are the means for establishing a creative contact with a hidden spiritual reality. Each such contact will lead to a new departure in a more or less unexpected direction, and it is precisely in order to find these directions that each scholar is made to act independently. In a process of surveying, on the other hand, the direction of progress is laid down in advance, and that is of its essence. Surveying entails therefore that the helpers engaged in it should accept a comprehensive scheme of progress laid down for them beforehand. When such a scheme is in existence, its filling out by the contributions of the individual surveyors can be directed by a central authority, and it is desirable that it should be so directed. The tasks of individual surveyors will be quite properly allocated to them from above; they have no claim to academic freedom.

It is also easy to dispose of the claim of applied scientists in industry or government offices to academic freedom. There is a good deal of confusion both intellectual, emotional and political on this subject. The obvious fact of the matter is that any research which is conducted definitely for a purpose other than that of the advancement of knowledge, must be guided ultimately by the authorities responsible for that outside purpose. Such external purposes are usually practical, like the waging of war, or the improvement of some public service, such as telephones or roads, or simply the earning of profits for a firm operating in industry. If the research worker is to serve any of these purposes he must submit his own contribution to the judgment of those who are ultimately responsible for waging war, running the telephone system, building roads, or making profits for a commercial enterprise. He must accept their ultimate decision as to what is required of him for their purposes. He will do his job well

only if, after due discussion, he does rely in the end confidently on the decision of the chief executive to whom he is responsible. There are of course many gradations in the degree of subordination that is essential to the successful working of the applied scientist. But there should be no difficulty in dealing with these intermediate cases on the basis of the same principle. You cannot serve two masters: you must choose between dedication to the advancement of a system of knowledge which requires freedom, or pursuit of applied science which involves subordination.

There is of course no difference in the personal respect due to the individual engaged in surveying or in applied science as compared with the respect due to a pure scientist. He may be the same man at different periods of his life. During the war a large number of academic scientists volunteered to do practical work. They all had to accept a measure of subordination. I merely say that certain tasks require for their efficient performance that men should be free, while others require that they should be subject to direction from above.

The Assertion of Freedom

Academic freedom is of course never an isolated phenomenon. It can exist only in a free society; for the principles underlying it are the same as those on which the most essential liberties of society as a whole are founded.

Our analysis of free academic activities has given us a clear conception of men and women evaluating hidden possibilities of the mind. We have observed them living in a common creative tradition and making contact with a spiritual reality underlying that tradition. We have seen them exercising their powers of intuition and judging their own ideas in the light of their intellectual conscience. Reference has been made to important analogies such as the function of judges and of ministers of religion. They can be readily extended further. For example, in a court room there are others than the judges who act on spiritual grounds. There are witnesses who may find it hard to tell the truth and yet do so. There are jurymen and counsel who must try to be fair and who may have occasion to wrestle with their consciences. Everywhere in the world there are people who are trusted by their fellowmen to tell the truth or to be fair. There are consciences touched by compassion, struggling against the ties of comfort or of harsh custom. Our lives are full of such conflicts. Wherever these contacts with spiritual reality are made there is an opportunity for asserting liberty. There are extreme cases—great examples in history—and there are many small instances every day of people who assert their liberty on grounds of this kind. A nation whose citizens are sensitive to the claims of conscience and are not afraid to follow them is a free nation. A country in which the spiritual things which appeal to our conscience are generally regarded as real, and where people are on the whole prepared to admit them as legitimate motives and even to tolerate inconvenience or hardship to themselves from others acting on such motives—such a country is a free country.

The Reality of Transcendent Ideas

These contacts with spiritual reality may reach high levels of creativity. They may inspire prophetic announcements or other great mental innovations. In some fields—as in science, in scholarship, or in the administration of the law—this may contribute to the development of an intellectual system: in which case we may observe a process of definite self-coördination. Yet all contacts with spiritual reality have a measure of coherence. A free people among whom many are on the alert for calls on their conscience will show a spontaneous coherence of this kind. They may feel that it comes from being rooted in the same national tradition: but this tradition may well be merely a national variant of a universal human tradition. For a similar coherence will be found between different nations when each follows a national tradition of this type: they will form a community of free peoples. They may quarrel indefinitely yet always settle each new difficulty in the end, being all rooted in the same transcendent ground.

Finally, let me return briefly to the great problem of the totalitarian danger at which I have hinted at the start. We can see two points emerging from our discussions of academic freedom and of freedom in general.

It appears, firstly, that the usual antithesis of the individual versus the State is a false

guide to the issue of freedom versus totalitarianism. The most essential freedoms at any rate are those in which it is not the individual pursuing his personal interests who claims to be respected by the State. Respect is demanded by the dedicated individual in view of the grounds to which he is dedicated. The disciplined individual demands to be respected for the sake of the spiritual reality under whose discipline he has undertaken to serve. He speaks to the State as a liegeman of a higher master demanding homage to this master. The true antithesis is therefore between the State and the invisible things which guide men's creative impulses and in which men's consciences are naturally rooted.

The totalitarian form of the State arises logically from the denial of reality to this realm of transcendent ideas. When the spiritual foundations of all freely dedicated human activities—of the cultivation of science and scholarship, of the vindication of justice, of the profession of religion, of the pursuit of free art and free political discussion—when the transcendent grounds of all these free activities are summarily denied, then the State becomes, of necessity, inheritor to all ultimate devotion of men. For if truth is not real and absolute then it may seem proper that the public authorities should decide what should be called the truth. And if justice is not real and absolute then it may seem proper that the government should decide what shall be considered just or unjust. Indeed, if our conception of truth and justice are determined in any case by interests of some kind or other, then it is right that the public interest should overrule all personal interests in this matter. We have here a full justification of totalitarian statehood.

The study of academic freedom which we have pursued may serve to show what is the decisive point in the issue of liberty. It consists in certain metaphysical assumptions without which freedom is logically untenable, and without the firm profession of which freedom can be upheld only in a state of suspended logic, which threatens to collapse at any moment and which, in these searching and revolutionary times, cannot fail to collapse before long.

The Motility and Flagellation of Bacteria

A. J. HODGE.*

This short article was prompted by a communication from G. C. Hughes (1948) in which attention was drawn to the theory put forward by Pijper (1941, 1946, 1947) to explain the motility of bacteria. Briefly, Pijper's theory states that the appendages usually referred to as flagella arise as a result of the motion of the bacteria and are not motile organs. Recent electron-microscopical evidence, together with certain other aspects not considered by Hughes (1948) have made it seem relevant to give an account of the experimental evidence which appears to render Pijper's theory invalid.

By way of opening the argument Hughes pointed out that flagella were tenuous in the extreme, and referred to the great difficulty encountered in attempting to demonstrate them in smears by various staining techniques. This difficulty is scarcely surprising when it is known that the average diameter of single flagellar threads, as determined by electron-microscopical* observation in this laboratory on a number of different genera, is about 200Å, while the limit of resolution of the optical microscope is of the order of 2000 Å. Occasionally, however, several of these flagella may be seen to lie together in a bundle, and it seems likely that it is these bundles of flagella that are observable in those cases where the conventional flagellar stains appear to be successful.

The fascinating question of whence the flagella derive their power is as yet unanswerable, but the problem cannot be dismissed by the statement that 'it can hardly be imagined that there is any equivalent of muscular power in the flagella'. On the contrary, electron-microscopical evidence indicates that close structural relationships exist among the various forms of contractile fibrous proteins. Hall, Jakus and Schmitt (1946) have shown that the contractile elements in striated muscle are extremely fine fibrils of diameter about 150 Å. In a similar manner it has been shown, in the industrial chemistry laboratory of the C.S.I.R., that the tails of certain spermatozoa, which are beyond doubt locomotor organs, consist of a number of fine fibrils enclosed in a membranous sheath. While it is true that there is at present no accurate physico-chemical knowledge of the mechanism of action of the flagella, this is equally true of the fibrils constituting the sperm tail, and the mechanism

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Some of the electron-microscopical work on bacteria carried out in the laboratory of the Division, and referred to in this article, will be published elsewhere.

of muscular contraction is as yet far from settled.

In spite of the difficulties associated with mounting of specimens, it has been shown with the electron microscope that certain species of bacteria possess characteristic modes of flagellation, viz., monotrichous, lopotrichous, etc. The difficulties arise as a result of the surface-tension forces during the drying of the specimen, and are of course encountered in all methods of examination other than *in vivo*. Distilled water also affects the flagellar material. Excellent illustrations of the mode of attachment of the flagella to the cell body and the occurrence of lopotrichy are to be found in a paper by Van Iterson (1947), who has demonstrated what appear to be basal granules or blepharoplasts to which the flagella are attached.

Hughes makes the surprising statement that there has been observed a proven absence of flagella when there was no question of a pronounced motility. The absence of flagella was presumably proved in this case by the use of flagellar stains and optical examination, but in view of the reasons already outlined this evidence cannot be taken seriously. In point of fact, electron-microscopical observations in the above-mentioned laboratory on a number of species, both motile and non-motile, have shown that flagella are invariably present in those organisms exhibiting motility.

Pijper has claimed that flagella should be referred to as 'polysaccharide twirls', but has not made it clear what evidence there is that they consist of a polysaccharide material. While it is known that many species of bacteria are able to produce polysaccharides, the conclusion that the flagella are derived from a polysaccharide slime layer does not appear to be justified. Dubos (1947), reviewing the evidence, is of the opinion that the flagellar

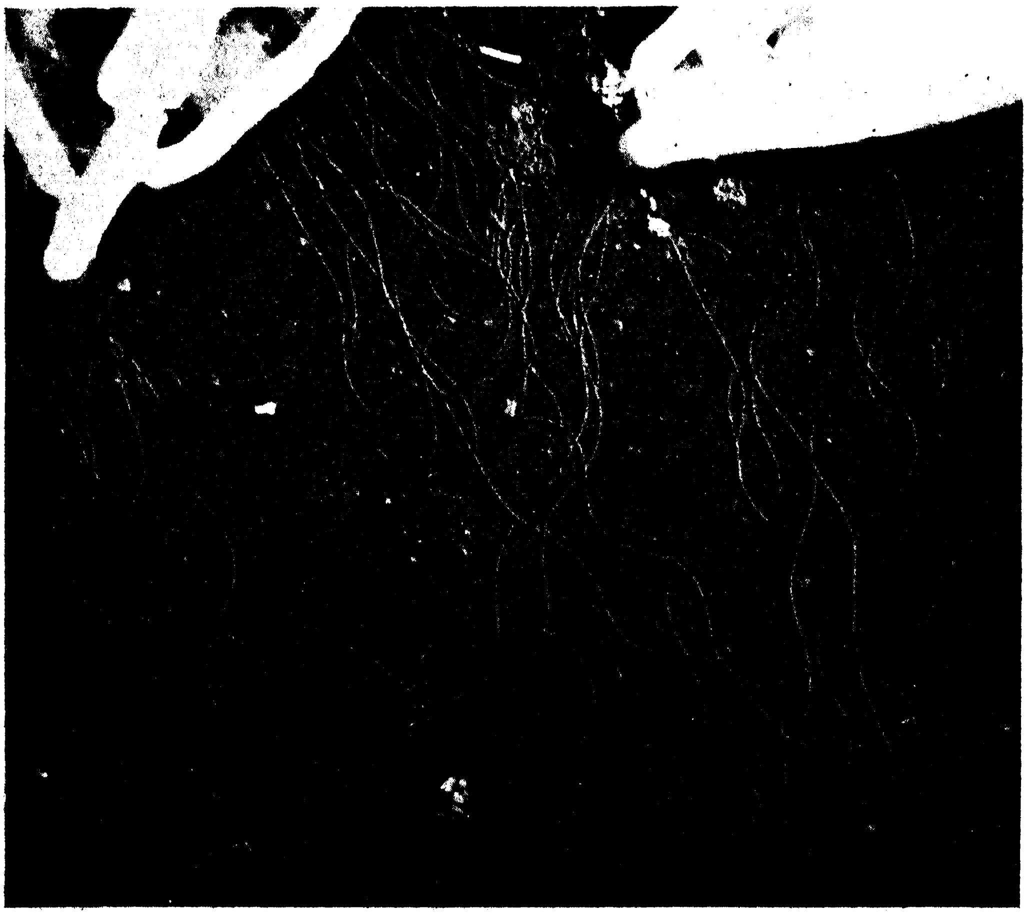

Figure 1.
Electron micrograph of a field of *Bacillus subtilis* from a 24-hour culture in broth.
Shadowed with platinum; ratio of shadow-length to object height, 4 : 1.
Print magnification, × 10,000.

material is protein in nature, an observation supported by the fact that it will combine with phosphotungstic acid to a considerable extent, this latter property forming the basis of a useful 'staining' technique for increasing the contrast of the flagella in electron micrographs (Figure 2). The sum total of evidence suggests that the flagellar material is a mucoprotein.

Hughes also states that, as the chemical and physical structure of the slime layer must vary considerably in keeping with the wide variation in immunological specificity, there is room for a good deal of variety in the appearance of the appendages which will arise (as a result of motion). Here again, the electron-microscopical evidence is able to discredit this point of view. The results to date have indicated that the diameters of flagella from widely varying genera fall within a narrow range of values, except in those instances where there has been specific adsorption on to the flagella, when considerable thickening may occur. Moreover, the diameters of flagella from single cells and from cells of the same species are remarkably constant (Figures 1 and 2) and show no signs of having arisen by the action of frictional forces on a polysaccharide slime layer. Indeed, they show every sign of being characteristic entities, although as yet no hard and fast characterization of genera or species has been attempted on the basis of electron-microscopical evidence. Additional evidence for this point of view has been provided by an electron-microscopical technique (Hillier and Baker, 1946) in which replicas are taken from young, actively-growing colonies on agar plates and examined in the electron microscope. The micrographs show that flagella are present in the colonies and lie on the surface in much the same manner as when the bacteria are deposited on the film from suspension. In this case there is no possibility of hydrodynamic forces shearing the slime layer off to form appendages; so that it seems certain that flagella, while not yet proved to be the motile organs, are nevertheless definite structural features present in motile organisms, and cannot be regarded as arising from a polysaccharide slime layer in the manner described by Pijper.

It is of interest to note that in electron micrographs flagella always present a wavy appearance, almost sinusoidal in nature; they

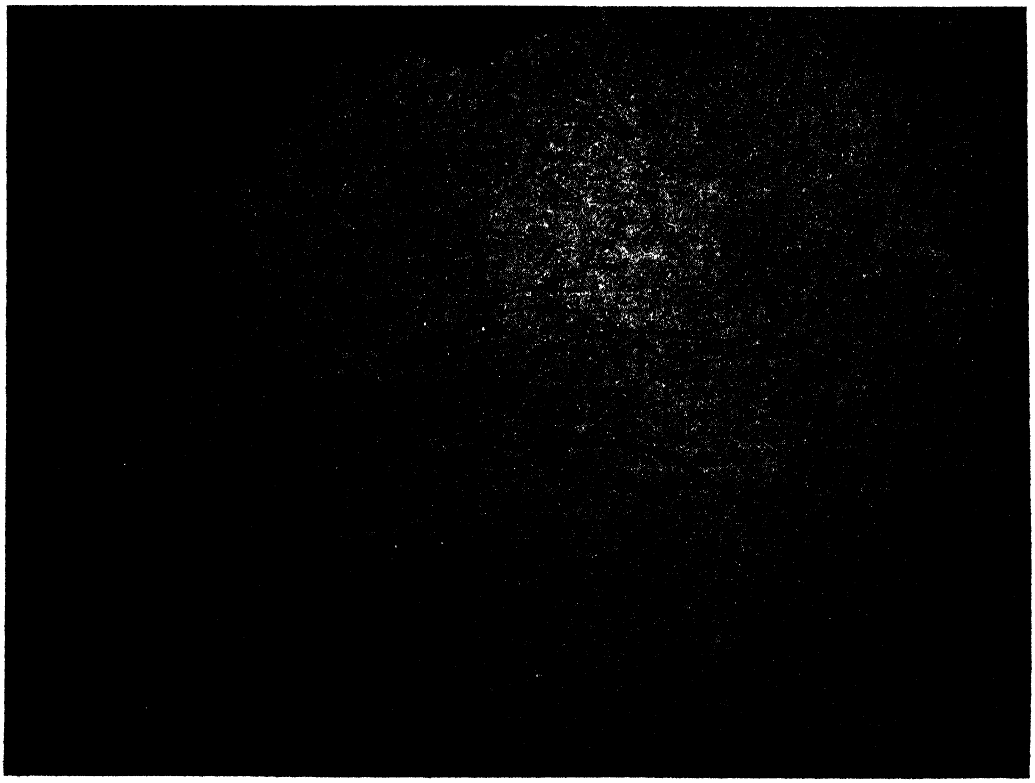

Figure 2.
Electron micrograph of a field of *Bacillus subtilis* from the same culture as in Figure 1. Stained with phosphotungstic acid to increase image-contrast. Print magnification, × 20,000.

presumably possess considerable rigidity, since this appearance is seldom lost except on breakage, in spite of the relatively enormous surface-tension forces which are encountered during drying of the smear. This appearance is what would be expected if the individual flagellar fibrils unwound themselves during drying from the spiral mass of the tail, as seen in Pijper's photomicrographs taken by the sunlight dark-ground technique. This phenomenon of separation of the constituent fibrils during drying is not uncommon and has been observed by electron microscopy in protozoan cilia (Schmitt, Hall and Jakus, 1943) and certain species of avian spermatozoa, where the tail membrane is unusually thin. It seems reasonable, therefore, to assume that the tails observed in moving bacteria are analogous to the appendages of certain spermatozoa and other zoological flagellates, whose motility is at least partially due to the activity of these structures.

Certain hydrodynamic aspects of the motion of bacteria are also helpful in the interpretation of the available evidence. The spiral form of bacterial cells as seen by Pijper cannot be demonstrated in all cases of motility. Perfectly symmetrical rods are rarely to be seen, however, and some degree of curvature appears to be the general rule. If we disregard the origin of the motility for the moment and consider a rod-shaped object propelled through a fluid medium, it will be seen that any degree of asymmetry will result in a periodic oscillation of the rod. Usually the asymmetry is such that this oscillation manifests itself as a rotation of the object about an axis parallel to the direction of motion, in such a way that the ordinary laws of hydrodynamics are satisfied. This is borne out by observation of slower-moving, rod-like organisms such as *Bacillus subtilis*, by hanging-drop technique. Moreover, in cultures of *Bacillus subtilis* may be seen comparatively long chains of cells, often arranged in a zigzag manner, the whole chain moving as a unit and rotating slowly about an axis of hydrodynamic symmetry parallel to the direction of motion. At first sight the rotation resembles a sinuous snake-like undulation, but this seems to be due to the limited depth of focus of the optical microscope: if, while observing a very slow-moving chain of cells, the microscope is focussed up and down, it will be seen that the group of cells maintains its zigzag form as a rigid unit. This observation suggests that the motility of such chains of cells arises from flagellar activity rather than cell-wall contortion.

The existence of certain motile strains of cocci is also rather interesting from the hydrodynamic point of view. It is difficult to see how an approximately spherical organism could attain speeds even comparable with those of rod-shaped organisms by contortion of the cell-wall, other than by gross distortion of shape, corresponding to an extremely rapid amoeboid movement. It seems rather more likely that the motility in these cases is due to the activity of flagella. Extending this argument, it seems pertinent to ask why it is that rod-shaped organisms of low axial ratio such as may be observed in cultures of *Salmonella typhi*, *Escherichia coli*, *Vibrio cholerae*, etc., are able to attain speeds considerably in excess of those exhibited by some of the longer rods. If Pijper's theory were applicable, we should expect some correlation between axial ratio and speed of the bacterium.

The phenomena of flagellar and somatic agglutinations are also of significance in any discussion of bacterial motility. As is well known, somatic agglutination occurs slowly to give fine granular floccules, which still exhibit some motility. This suggests that 'O' antibody globulin is specifically adsorbed on the cells, but not on the flagella, and the motility is unaffected except by the subsequent slow agglutination to give closely-packed masses of cells. It seems highly unlikely that such masses of cells would be able to move by means of cell-wall contortion.

Pijper (1938, 1940) has claimed that 'H' anti-sera have no real agglutinating action, the mechanism being that flagella and cell-body are covered with a thick layer of globulin. Fortuitous entanglement of the stiffened flagella then results in loose floccule formation. It has been shown, however (Mudd and Anderson, 1941), that specific antibodies combine with somatic and flagellar antigens of non-capsulated bacteria to form deposits on the cell-wall and flagella respectively. Secondary adsorption of non-specific serum components may then occur on the antigen-antibody complex (Mudd and Anderson, 1944). Further work is indicated in this direction. A likely explanation of the loss of motility is the adsorption of the 'H' antibody globulin on the thin flagella, since a relatively thin coating of globulin would seriously hamper any flagellar activity.

Summing up the situation on the basis of available evidence, it appears that the relatively perfect standardization of the flagella and their characteristic appearance as seen in the electron microscope is incompatible with Pijper's description of them as 'polysaccharide twirls'. They must be regarded as definite structural features of the bacterial cell. Whether they may be regarded as protoplasmic in origin is debatable, but in this connexion the demonstration of basal granules is significant. While it is not yet proven that the flagella are the locomotor organs of the cell, a consideration of certain hydrodynamical aspects of bacterial motility, the phenomena of somatic and flagellar agglutination and the striking structural similarities existing in flagella, cilia, sperm tails and striated muscle, suggest that this is so. It seems probable that motion is imparted to the bacterium by a number of flagella twisted or otherwise linked together to form a spiral tail.

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The Specimen, the Species and the Botanist

S. T. BLAKE.*

Man has ever sought to classify the objects of his environment for greater ease in the retention and communication of concepts and information. In referring to such classified objects man makes use of a spoken or written symbol which is called the *name* of the object (cf. Ogden and Richards, 1945, ch. 1). All botanical work depends upon the correct application, to the plant studied, of a name in accordance with current ideas of classification. In botany, the classification of organisms as a whole is usually called 'taxonomy' or 'systematics': the two terms are now usually regarded as synonymous, though theoretically there is a slight though definite distinction, in that taxonomy deals rather with the principles of classification while systematics is concerned with the classification of objects within a nomenclatural system. Nomenclature deals with the terms which denote taxonomic groups and the names which are applied to the individual groups (International Rules of Botanical Nomenclature, Art. 8). The process of referring an organism to its appropriate, named group is commonly called 'identification' or 'determination'. This process also is commonly, though loosely (and, as I hope we shall see, erroneously), called 'naming' the plant or specimen.

The species is usually regarded as the unit of classification in systematics, but to define a species is as difficult as it is to define time or space. However, as Camp and Gilly have stated (1943, p. 331), it is now generally accepted that, in the last analysis, the species is not necessarily a particular kind of organism: it is a kind of population. Populations differ from one another in different ways and in different degrees; they are regarded as being different species chiefly because of the sharpness of the differences between them, not because of the number or kind of different characters. In other words, different species are populations between any two of which there is a distinct discontinuity. Camp and Gilly also stress that two principles must be accepted as necessary: firstly, that species do not possess the same amount of internal genetic variability; and secondly, that all individuals of a species may not exactly match a particular specimen which, because of an accident of exploration, is to be considered the nomenclatural type.

* Queensland Herbarium, Botanic Gardens, Brisbane. This paper is slightly modified from one read before Section M, A.N.Z.A.A.S., Perth Meeting, 1947.

One of the primary processes in systematics is to recognize the various kinds of populations encountered: that is, to distinguish the various species, one from another. This may be attempted in different ways. The worker may go into the field and study as many populations as possible over as wide an area as possible. In practice, of course, there are definite limitations to such a method, imposed by considerations of time, distance and finance. Living plants may be brought into cultivation and studied over a period of time, but here again there are limits imposed by the number of individuals available and the time taken for such individuals to grow. A third method is one generally current, which is the study of specimens preserved in some museum or herbarium. In spite of the disadvantages to be discussed later, this has the advantage of allowing the worker to study at his leisure a wide range of specimens. This leisure to study a range of material is an important factor. There is time to check and recheck observations, and this in itself allows time for the proper appreciation of the importance to be attached to apparent discontinuities between groups of specimens available. And it also gives a clue to the nature of the field observations to be made when the opportunity arises.

There is also, however, a dangerous side to this leisured study of herbarium specimens. By stressing the specimen too much, there is a tendency to confuse specimen with species. How frequently one hears or reads that this or that specimen is *Eucalyptus torquata* or *Eragrostis falcata*, when the truth is that the specimen is a fragment of a population which we symbolize by the term *Eucalyptus torquata* or *Eragrostis falcata*, etc. The same style of loose expression leads to the use of such terms and phrases as 'species-maker', 'he made several species' of this or that, etc. In a recent publication (Black, 1943, p. 165) the author stated that I made the species *Cladium procerum* of the Australian plants: he referred to *Cladium mariscus*; but I certainly did not create the population. The fact was that a detailed study of specimens from many parts of the world led me to the conclusion that there were marked discontinuities between the numerous populations which by some had all been called *Cladium mariscus*; I then gave a distinguishing name to the popu-

lation inhabiting Australia and New Caledonia, at the same time indicating just how this population does differ from the other populations and in general complying with the conditions for describing species as laid down in the International Rules of Botanical Nomenclature.

One great drawback of the purely herbarium method is that many workers tend to lose all sense of proportion when specializing in a group and to treat each specimen as though it were a perfect representation of some population, to which some name must be attached if it at all differs in any feature from other available specimens. In some cases this results in giving a name to nearly every specimen seen. According to the attitude of the particular worker to infraspecific nomenclature, so the form of the name may vary, but the point is that fragments—so-called specimens—and not populations, are being named. The polycategorical nomenclatures used by some botanists, chiefly in Europe, tend to stress the specimen, not the species.

This kind of taxonomy may result from several causes, among which may be mentioned:

(*a*) insufficient acquaintance with plants as organisms—the worker is acquainted with the plants chiefly as herbarium specimens—this has been mentioned above;

(*b*) insufficient realization of the variation between and on individuals of any population, however homogeneous—this will be amplified when discussing the 'specimen';

(*c*) a tendency to treat the similarities and differences exhibited by specimens or organisms as amenable to the processes of formal logic.

The last cause is frequently encountered amongst those workers whose experience with plants is more or less confined to the herbarium or to horticulture. One extreme case of this is the monograph on apples cited by W. J. Hooker (1855) in which there are described no less than 15 genera and 1263 species! While this may be an 'exaggerated attempt to classify the unclassifiable', it does suggest how difficult some problems in systematics really are. In Australia we know of several, some at the species level, others at the generic level. But I think that the general attitude of botanists and others to these difficulties could be much more sympathetic if it were clearly realized that there are several different kinds of species (cf. discussion by Camp and Gilly, 1943). There are species of plants, reasonably well known, of which the individuals are so remarkably similar to one another that a description based upon any well developed specimen will apply to any other specimen. Most of the dozen or so Australian species of *Iseilema* (Gramineae) are like this. The species of *Parsonsia*, a genus of the Apocynaceae represented in Australia by about 24 species of lianas, are remarkably distinct from one another in a number of characters, particularly in floral structure. In the majority of these, the individuals of any one species are also very much alike, provided that similar parts of the individuals are compared, though there may be a high degree of variation in size, shape and texture of the leaves from different parts of any one plant. The leaves of the flowering branches may be quite different in shape from those on the sterile shoots and, in addition, those exposed to the sun are often smaller, tougher, thicker and sometimes relatively narrower than the shade-leaves; in some species the juvenile leaves are very different from the adult leaves.

The other extreme is in those cases where no two specimens of a genus appear quite to match, and it is here that the worst difficulties are met with. There is a strong temptation sometimes to 'lump' all the forms encountered as representing individuals of a highly polymorphic species, sometimes with the more distinctive forms distinguished as 'varieties'. Few botanists will doubt that there are species which exhibit a high degree of variability, often within a small area. But there is also a possibility that we may be dealing with a series of closely similar species, the differences between which are not obvious for one or more of the following reasons:

(*a*) A rather common form is represented in herbaria by a number of specimens while other forms are less well represented.

(*b*) The form first collected may belong to a species with a relatively restricted range and, by some chance of exploration, the locality may have been visited early in the nomenclatural history of the group and, owing to the inaccessibility of the area, may not have been revisited since. The name becomes a puzzle and later workers are tempted to refer allied, better known forms to the original name. This has occurred in several instances with specimens collected by Banks and Solander at the Endeavour River in 1770 and by Robert Brown in the region of the Gulf of Carpentaria in 1802-3.

(*c*) The group may be represented by a large proportion of unsatisfactory specimens. Unbeknown to the herbarium worker, none, or almost none, of the specimens gives a really good idea of the individual organism.

I have met with most of these difficulties in studying the genus *Fimbristylis* (Cyperaceae). About fifteen years ago I began revising the Australian species of this genus, and since then I have had the opportunity to study in the field and collect specimens of nearly all of the eighty to ninety species known to occur on this continent and (particularly during the past few years) to become rather well acquainted with many of the species from New Guinea and other parts of Malaysia and

India. A great part of the material in herbaria is of relatively little value for critical work. In this genus there is a vast array of externally similar forms which, from an unhappily large proportion of the so-called specimens, it would be almost impossible to classify. But the position is very different when a good series of complete plants in mature fruit becomes available. The species, though numerous, can then be defined rather sharply and the diagnostic value of minute external differences is better appreciated.

Inadequacy of material for study, either as regards quantity or quality or both, is the greatest handicap to systematics, and it is probably the reason for many of the difficulties facing Australian botanists today. The *specimen*, as such, has been far too greatly neglected.

A specimen is an individual representative of the population, or a piece or a series of pieces of an individual, representative of that individual and this in its turn of the population. It is often impossible to obtain a piece of a size within the limits of a herbarium sheet which is at all representative, even though such a piece may be folded backwards and forwards. In such cases a specimen, to be worth calling such, consists of two or more pieces distributed over perhaps a number of herbarium sheets. Some groups of plants, such as palms, Pandanaceae, Musaceae, species of *Banksia*, and certain grasses and Cyperaceae, are especially difficult to represent by herbarium specimens, and special methods have to be evolved for these; but I do not propose to discuss the more difficult cases.

In the genus *Eucalyptus*, the value of juvenile leaves has been known for some time, and it appears to be recognized (at least in theory) that a good specimen of a eucalypt should show at least juvenile leaves, mature leaves, bark, buds, flowers and fruit. However, there is a tendency to regard this genus as an exceptional case, in spite of the fact that in many families both flowers and fruit are required for generic determination, and that there are very many species which exhibit a striking variation in leaf-shape and leaf-size on the same plant. If the plant is a small one, then the specimen may well consist of a complete plant; but in many species, particularly those of the rain-forest, the leaves or the inflorescence or both may be so large that it is extremely difficult to provide even the minimum requirement of a flowering or fruiting twig, while to show variation on the same plant is even more difficult. The figures, from photographs of specimens in the Queensland Herbarium mounted on standard-sized sheets, illustrate two cases which are certainly not extremes, for the leaves are not particularly large and the inflorescences are relatively small. Figures 1 to 3 are from three sheets of a specimen of *Helicia diversifolia* C. T. White showing leaf-variation on one branch; a fourth sheet, carrying a juvenile leaf which had to be folded at about one-quarter of its length above the base, is not shown. Figure 4 is from a specimen of *Dysoxylum muelleri* Benth. (a species with compound leaves), while at B are comparable specimens (each with two leaves and an inflorescence) of two species of *Leucopogon*. At A, A, leaflets have been cut away to prevent overcrowding the sheet. It is not suggested that the variation in leaf-form is commonly so pronounced as in *Helicia diversifolia*, but it is usually present in some degree.

There are limits to the information to be obtained from the piece or pieces constituting the average specimen. It is usually understood that what is not obvious from the specimen should be made clear by notes, sketches or photographs accompanying the plant material, but every worker knows how rarely this happens. Such notes are regarded as a luxurious appendage rather than a necessity; and it must be admitted that field-notes can be misleading. On more than one occasion, and in different herbaria, I have found specimens of lianas with notes stating that the plant was a tall tree! Barks are described in very different terms by different observers.

It does seem to me, however, that if more attention were paid to collecting adequate herbarium specimens, the difficulties of systematists would be greatly decreased. Identification would be the more reliable, and there would be fewer of those name-changes which are so vexatious to the botanist and so little understood by the non-systematist, but which frequently are merely the result of a better understanding of the species in question. In biology, the name of a species is a symbol consisting of two words by means of which we refer to the particular population. It is not a description of a plant, neither is it a memorial to some person either living or dead. In as much as the first word is the name of the genus, it does convey some information concerning the position of the species in our adopted scheme of classification of organisms; therefore, if further study suggests that a species has been wrongly placed in this scheme of classification, a change of name is rendered necessary. (No one seriously objects to a chemist or physicist changing his ideas about the structure of the atom, which until quite recently was defined as the ultimate indivisible particle of matter.) In botany, the second word of the name is purely and simply an epithet (as is stated in the International Rules of Botanical Nomenclature, Art. 27). It is not a *name*, being adjectival in form or function; it is quite incorrect to refer to it as the 'specific name', as is still sometimes done. When we make use of such a phrase as 'that is *Eragrostis falcata*', what we should really mean is that 'that is a specimen (or individual, or group of individuals) of the population symbolized by the name *Eragrostis falcata*'.

It should be superfluous to suggest that the introduction of a new name to systematic

Figure 1.

Figure 2.

Figure 3.

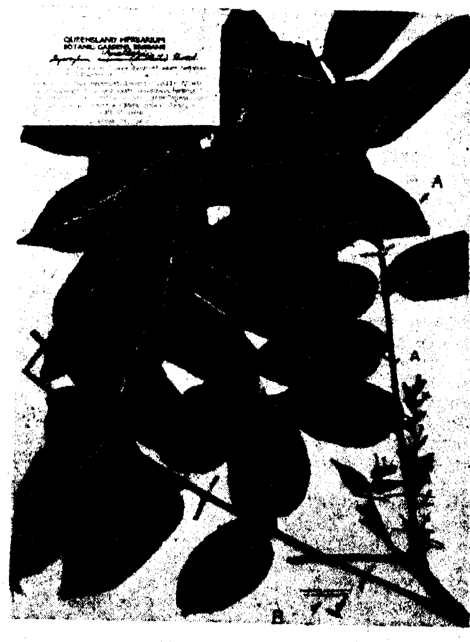

Figure 4.

Figs. 1-3: Three sheets of a specimen of *Helicia diversifolia* C. T. White (*S. T. Blake* 15225). Fig. 4: A specimen of *Dysoxylum muelleri* Benth. (*S. T. Blake* 15501) with some leaflets cut away, as at A, A. At B are comparable pieces of two species of *Leucopogon*. Further explanation in the text. Figures between ¼ and ⅓ natural size.

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

February, 1949

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All communications concerning abstracts should be addressed to the Editor.

Vol. 27 **No. 4**

BIOCHEMISTRY.
(Continued.)

14875. **Kratzing, C. C.** Effect of Thiamine Deficiency on the Urinary Excretion and Liver Content of Riboflavin in the Rat. *Aust. J. Exp. Biol. Med. Sci.*, xxv, 1947, 157.—In acute thiamine deficiency, increased excretion of riboflavin occurs simultaneously with loss of body weight. Similar loss of riboflavin occurs with insufficient food intake. Liver riboflavin is unchanged in thiamine deficiency.

14876. **Kratzing, C. C.** The Effect of Thiamine and Calcium Supplements on the Development of Signs of Pyridoxine Deficiency. *Aust. J. Exp. Biol., Med. Sci.*, xxvi, 1948, 45.—Pyridoxine deficient female rats supplemented with extra thiamine or thiamine plus calcium do not produce pyridoxine-deficient young.

14877. **Lascelles, June, and Still, J. L.** The Utilization of Fumarate and Malate by *Escherichia coli* in the Presence of Molecular Hydrogen. *Proc. Linn. Soc. N.S.W.*, lxxii, 1947, 49.—Reduction of fumarate and malate by washed suspensions of *E. coli* was studied, both systems having similar properties. Dintrophenol and o-phenanthroline inhibited the uptake of hydrogen. Toluene treated cells and cell-free extracts were also studied.

14878. **Lugg, J. W. H.** Extension of our Understanding of Protein Function in Living Organisms. *Aust. J. Sci.*, x, 1948, 132.—Review.

14879. **Lugg, J. W. H., and Weller, R. A.** Partial Amino-acid Compositions of Some Plant-leaf Protein Preparations: the Arginine, Histidine and Lysine Contents. *Biochem. J.*, xlii, 1948, 408.—Amino-acid analyses were made of senescent leaves of *Trifolium subterraneum*. It was concluded that the onset of senescence was accompanied by an increase in cysteine and possibly tyrosine, and a decrease in the methionine content of the whole protein of the tissues.

14880. **McDonald, I. W.** The Absorption of Ammonia from the Rumen of the Sheep. *Biochem. J.* xlii, 1948, 584.—It was shown that ammonia is absorbed from the rumen. The circulation of nitrogenous compounds in digestion was outlined.

14881. **Marston, H. R.** The Fermentation of Cellulose *in vitro* by Organisms from the Rumen of Sheep. *Biochem. J.*, xlii, 1948, 564.—It was possible to develop *in vitro* conditions simulating those of the normal rumen. Products of fermentation were isolated and carbon and energy balance sheets drawn up. These results were discussed in relationship to the energy-metabolism of ruminants.

14882. **Nossal, P. M.** The Metabolism of Erythrocytes. i. Respiration in the Absence and Presence of Methylene Blue. *Aust. J. Exp. Biol. Med. Sci.*, xxvi, 1948, 123.—Mature rabbit erythrocytes were used. Citric and dicarboxylic acids increase the oxygen consumption; some amino acids have an inhibitory action. In the presence of methylene blue, hexoses also increase the oxygen consumption.

14883. **O'Brien, B. R. A.** Studies in the Metabolism of Normal and Regenerating Tissue of the Earthworm. Part i. Factors Affecting the Endogenous Oxygen Consumption of Normal and Regenerating Muscle Tissue. *Proc. Linn. Soc. N.S.W.*, lxxii, 1947, 367.—Terminal posterior segments of *Allolobophora* sp. were shown to maintain a higher Qo_2 of regenerating tissue increases as regeneration proceeds.

14884. **Rogers, W. P.** The Respiratory Metabolism of Parasitic Nematodes. *J. Parasitol.*, xxxix, 1948, 105.—The direct Warburg method was used to obtain R.Q. values of the eggs, larvæ and adult forms of several parasites. KCN inhibited respiration in all cases.

14885. **Saul, J. A., and Trikojus, V. M.** The Conversion of DL-3:5-Diiodo-4-hydroxyphenyllactic Acid into an Analogue of Throyxine. *Biochem. J.*, xlii, 1948, 80.—A new compound (lactic acid analogue of thyroxine) has been isolated.

14886. **Shorland, F. B., and Russell, J.** New Zealand Fish Oils. 4. Observations on the Oil Content of Fresh Water Eels. *Biochem. J.*, xlii, 1948, 429.—The distribution and content of oil were determined. The results indicate that just prior to migration a more uniform distribution of oil is attained by a partial transfer of oil from the tail into the trunk and thence to the head and ovary.

14887. **Winikoff, Dora, and Trikojus, V. M.** N'-Diethylsulphanilamide: a Reagent for the Colorimetric Estimation of Thyroxine. *Biochem. J.*, xlii, 1948, 475.—The colour test is carried out in alkaline solution; a procedure is suggested for the determination of thyroxine.

VETERINARY SCIENCE.

Hon. Abstractors: D. Stewart, (1) M. C. Franklin, (2) N. Wickham, (3) H. McL. Gordon, and (4) D. C. Blood.

(1) BIOCHEMISTRY AND NUTRITION.

14888. **Austin, C. R., Whitten, W. K., Franklin, M. C., and Reid, R. L.** The Effect of Hexoestrol on the Food Intake of Sheep. *Aust. J. Exp. Biol. Med. Sci.*, xxv (4), 1947, 343–346.—Ewes treated with hexoestrol suffered marked depression of appetite. The effect was brief, and continued inappetence was produced only when hexoestrol was administered every two or three days.

14889. **Curnow, D. H., Robinson, T. J., and Underwood, E. J.** Œstrogenic Action of Extracts of Subterranean Clover (*T. subterraneum* L. var. *Dwalganup*). *Aust. J. Exp. Biol. Med. Sci.*, xxvi (2), 1948, 171–180.—Crude ether extracts have been prepared from subterranean clover (*T. subterranean* L. var *Dwalganup*) from a pasture in Western Australia on which occurs a breeding problem of sheep characterized by three main manifestations: female infertility, dystocia, and uterine prolapse. These extracts, when fed to guinea-pigs and mice, produced uterine and vaginal changes qualitatively similar to those produced by the injection of a known œstrogen, œstradiol.

14890. **Ewer, T. K., and Bartrum, P.** Rickets in Sheep. *Aust. Vet. J.*, xxiv (4), 1948, 73–85.—Rickets has been shown to occur in hoggets in Canterbury (N.Z.) when over-wintered on Italian rye-grass, turnips, choumoellier and young mixed pasture. Cereals proved to be the most rhachitogenic. The authors postulated that some specific principle interferes with phosphorus metabolism and is found in highest concentration in green cereal crops.

14891. **Johanson, R.** The Cystine Plus Cysteine and Methionine Contents of the Seed Proteins, and Sulphur Distributions of Seeds of *Vicia* spp. (Vetches), with Notes on their Cyanogenesis. *Aust. J. Exp. Biol. Med. Sci.*, xxvi (4), 1948, 259–270.—The seeds of two Vicia species (the autocyanogenetic *Vicia* sp. *sativa* and non-cyanogenetic *Vicia dasycarpa* Ten.) have been examined with special regard to the sulphur distributions, and to the cyst(e)ine and methionine contents of the "whole proteins". Ten out of 23 varieties or strains of genus *Vicia* tested were found to be autocyanogenetic.

14892. **Lee, H. J., and Moule, G. R.** Copper Deficiency Affecting Sheep in Queensland. *Aust. Vet. J.*, xxiii (11), 1947, 303–309.—Evidence is presented that copper deficiency symptoms may occur among sheep in Queensland. This deficiency results in the production of a lesion in the wool which is identical with that occurring in areas elsewhere in Australia known to be deficient in copper.

14893. **Marston, Hedley R.** Energy Transactions in the Sheep. I. The Basal Heat Production and Heat Increment. *Aust. J. Sci. Res.* (Series B), i (1), 1948, 93–129.—The author has summarized existing knowledge of the respiratory metabolism of the sheep and discusses outstanding problems. Experimental work includes a series of critical determinations of the complete energy balance sheets of a number of Merino ewes, each observed at five levels of food intake extending from approximately ½ to 2 maintenance. The fasting (basal) heat production has been investigated critically at these levels of feeding and it has been shown that the "true basal" energy requirement of the steer and sheep are closely related to the 0·73 power of their bodyweights. The heat increment of the source of energy drawn from the tissues during fasting was estimated at 20%. The combustible energy, available energy, heat increment and useful energy of experimental rations have been investigated and accurately defined.

14894. **McClymont, G. L.** The Effect of Grazing Oats on Butter-fat Content of Milk. Need for Coarse Roughage. *Agric. Gaz. N.S.W.*, lviii (10), 1947, 551–553.—Grazing dairy cattle on young oats, with concentrates only fed in addition, reduces the butter-fat content as much as 40% without any decrease in the volume of milk or any apparent affect on the health of the cattle. Supplementing the grazing oats with coarse roughage prevents this depression in fat content.

14895. **McClymont, G. L.** Comparative Value of Urea and Protein for Supplementing Low Protein Rations for Growing Cattle. *Aust. Vet. J.*, xxiv (8), 1948, 197–204.—The efficiency of urea in comparison with protein, for stimulating growth in excess of that obtained from basal rations of wheaten chaff and cereal grains averaged 59·9%. This efficiency did not appear to be affected by proportion of grain to roughage in the basal ration.

14896. **McClymont, G. L., and Hart, L.** Studies on Nutrition of Poultry. 2. Investigations on the Effect of Vitamin *A* Deficiency on Hatchability and Egg Production. *Aust. Vet. J.*, xxiv (1), 1948, 5–12.—Vitamin *A* deficiency, while resulting in cessation of egg production and eventual death, and in the production of chickens with low vitamin *A* reserves, had no effect on fertility, hatchability or incidence of embryo abnormalities.

14897. **Moule, G. R.** Milk Fever (Hypocalcæmia) and Pregnancy Toxæmia of Ewes. *Qd. Agric. J.*, lxv (5), 1947, 332–337.—A useful survey of existing knowledge.

14898. **Moule, G. R.** Hand Feeding of Stud Sheep. *Qd. Agric. J.*, lxv (4), 1947, 245–264.—The author deals with the composition and utilization of foodstuffs, the effects of feeding at different nutritional levels, feeding standards, how to calculate rations, and several diseases associated with faulty feeding of stud sheep.

14899. **Pilgrim, A. F.** The Production of Methane and Hydrogen by the Sheep. *Aust. J. Sci. Res.* (Series B), i (1), 1948, 130–138.—Studies on the rate of production of methane by sheep and the effects of fasting and refeeding on the production of methane and hydrogen support the hypothesis that at least two organisms are involved in the production of methane, one producing hydrogen and another catalysing the reduction of carbon dioxide to methane by the hydrogen so formed.

(2) BACTERIOLOGY.

14900. **Buddle, M. B.** Vaccination against Bovine Brucellosis. *Aust. Vet. J.*, xxiv (7), 1948, 171–176.—This is a record of strain 19 vaccination in New Zealand, with comments on developments in immunization procedures.

14901. **Gray, D. F.** A Simple Vacuum Drying Apparatus for Preserving Bacterial Cultures. *Aust. Vet. J.*, xxiv (3), 1948, 66–68.—Details are given of the construction of an apparatus for drying bacterial cultures, and of the preparation of cultures to be dried, their storage and the method of recovery of the organism.

14902. **Hayston, J. T.** Actinobacillosis in Sheep. *Aust. Vet. J.*, xxiv (3), 1948, 64–66.—An outbreak of actinobacillosis in sheep is described. Approximately 25% of the ram population of a Merino stud showed small abscesses in the skin and lymphatic glands of the lower jaw, and occasionally in the masseter muscles and the mucous membrane of the head. Cultural examination of these abscesses revealed *A. lignieresi.* Treatment with potassium iodide proved effective.

14903. **Josland, S. W.** Salmonellosis of Swine in New Zealand. *Aust. Vet. J.*, xxiii (10), 1948, 292–293.—The methods used in the isolation and examination of Salmonella organisms from cases of infectious enteritis in pigs are described. In twenty-three different outbreaks of this disease *S. choleræ suis* was recovered and each time the strain was shown to be of the diphasic variety.

14904. **Nicol, G.** The Control of Pullorum Disease. *Aust. Vet. J.*, xxiii (10), 1948, 294–300.—Conditions governing the Pullorum Accreditation Scheme instituted in Victoria in 1947, the details of the method of testing, and the procedure followed after testing, are described. A similar outline of the Queensland technique, given by L. G. Newton, is appended.

14905. **Rodwell, A. W.** Observations on Various Factors Influencing the Viability of *Br. abortus* strain 19 vaccine. *Aust. Vet. J.*, xxiv (5), 1948, 133–143.—Results of this series of investigations showed the viability of *Br. abortus* strain 19 suspended in buffered saline could be maintained at a satisfactory level (8×10^9 viable cells per ml.) for three months if stored at 4° C. Viability was adversely affected by longer storage, by rubber—particularly acid washed rubber, by a decrease in pH (optimum 6·30) and by increased temperature. The substrain used in the preparation of the vaccine was also found to be important. Fresh cultures received from the U.S. Bureau of Animal Industry had a high initial viable count which was maintained during storage.

14906. **Sutherland, A. K., and Moule, G. R.** Malignant Œdema of Lambs in North-western Queensland. *Qd. J. Agric. Sci.*, iv (1 and 2), 1947, 12–19.—Heavy and repeated losses in lambs following marking were investigated, and found to be due to *Clostridium septique* infection. Losses were confined to male lambs indicating that the castration wound, and not the tail wound, was the portal of entry for the organism. A reduction in mortality followed the use of temporary yards for marking.

14907. **Talbot, R. J.** Vaccination against Brucellosis. *Aust. Vet. J.*, xxiv (7), 1948, 176–178.—This paper reports the progress of Brucellosis vaccination in Victoria.

14908. **Whitten, L. K., Harbour, H. E., and Allen, W. S.** Cutaneous Erysipelothrix Infection in Sheep. An Etiological Factor in Post-dipping Lameness. *Aust. Vet. J.*, xxiv (7), 1948, 157–163.—Outbreaks of lameness in sheep following dipping in derris or benzene hexachloride were investigated and found to be due to *Erysipelothrix rhusiopathiæ* infection. The organism gained entrance through small skin abrasions around the coronet, setting up a local inflammatory reaction with secondary involvement of the laminæ of the hoof. These dips contain no bacteriostatic agent so that the percentage of the flock affected increased with the length of time the dip was allowed to stand. The addition of copper sulphate was found effective in rendering the infected wash innocuous.

14909. **Blood, D. C., Gaven, C. P., and Astill, K. J.** Toxicity of Gammexane for Cats. *Aust. Vet. J.*, xxiv (5), 1948, 131.—A fatal case is described.

14910. **Clare, N. T.** A Photosensitized Keratitis in Young Cattle Following the Use of Phenothiazine as an Anthelmintic. II. The Metabolism of Phenothiazine in Ruminants. *Aust. Vet. J.*, xxiii (12), 1947, 340–344.—These studies have established the importance of phenothiazine sulphoxide among the metabolic products of phenothiazine. The nature of the excretion products varies from species to species and within one species according to factors such as age and dose rate. In calves the conversion of sulphoxide to phenothiazone in the liver is not complete and the presence of the sulphoxide in the systemic circulation may lead to photosensitized keratitis.

14911. **Clare, N. T., Whitten, L. K., and Filmer, Daisy B.** A Photosensitized Keratitis in Young Cattle Following the Use of Phenothiazine as an Anthelmintic. iii. Identification of the Photosensitizing Agent. *Aust. Vet. J.*, xxiii (12), 1947, 344–348.—The oxidation product, phenothiazine sulphoxide, in the circulation and the aqueous humour of the eye was shown to be the cause of sensitization to sunlight.

14912. **Gorrie, C. J. R.** Balling Gun Injury in Sheep. *Aust. Vet. J.*, xxiv (6), 1948, 148–149.—Inexpert use of a balling gun for administration of phenothiazine tablets resulted in injuries to the retropharyngeal region.

14913. **Lawrence, J. J.** The Cultivation of the Free-Living Stages of the Hookworm, *Ancylostoma braziliense* de Faria, Under Aseptic Conditions. *Aust. J. Exp. Biol. Med. Sci.*, xxvi (1), 1948, 1–8.—Larvæ of *A. braziliense* developed to the third stage in suspensions of living, but not dead, bacteria. They also developed in sterile media containing fresh rabbit tissue and water agar.

14914. **Oxer, D. T.** The Preparation of Canine Anti-Tick Serum. *Aust. Vet. J.*, xxiv (4), 1948,

95–96.—The preparation of hyperimmune serum for the treatment of dogs and other animals affected by tick paralysis following engorgement of the tick *Ixodes holocyclus* is described.

14915. **Rainey, J. W.** Equine Mortality due to Gastrophilus Larvæ (Stomach Bots). *Aust. Vet. J.*, xxiv (5), 1948, 116–119.—A number of cases of fatal peritonitis in horses in Tasmania are thought to have been caused by larvæ of *Gastrophilus* spp.

14916. **Rogers, W. P.** The Integration of Biological, Chemical and Pharmacological Investigations in the Search for Efficient Anthelmintics. *Aust. Vet. J.*, xxiv (8), 1948, 220–225.—The role of critical experimentation in chemotherapy is discussed from the point of view of (1) biological experiment to seek metabolic characters of the parasite, (2) chemical investigation to develop biological antagonisms, and (3) pharmacological investigations to correlate the properties of compounds developed in the chemical investigation.

14917. **Seddon, H. R.** Host List of Helminth and Arthropod Parasites Present in Domestic Animals in Australia, with Notes on their Presence in the Several States, and Lists of Parasites which have not become Established, Doubtful Records, etc. *Commonwealth of Australia, Dept. of Health, Science Publication* (*Division of Veterinary Hygiene*), *No.* 2.—This is a host parasite check list and geographical record of the helminth and arthropod parasites of domestic animals in Australia.

14918. **Whitten, L. K.** The Anthelmintic Efficiency of Phenothiazine Sulphoxide against *Hæmonchus contortus* and Certain Large Bowel Parasites of Sheep. *Aust. Vet. J.*, xxiv (5), 1948, 114–115.—The sulphoxide is the chief oxidation product in ruminants of the anthelmintic, phanothiazine, and is the first derivative of this drug to show marked anthelmintic efficiency.

14919. **Whitten, L. K., and Filmer, Daisy B.** A Photosensitized Keratitis in Young Cattle Following the Use of Phenothiazine as an Anthelmintic. i. A Clinical Description with a Note on its Widespread Occurrence in New Zealand. *Aust. Vet. J.*, xxiii (12), 1947, 336–340.—The condition is described and has been shown to be dependent on the action of light falling on the cornea. Trauma occurs between 12 and 36 hours after administration of phenothiazine, during which time blood concentrations of phenothiazine derivatives are highest.

(4) VETERINARY SURGERY AND MEDICINE.

14920. **Bangs, C. L., and Underwood, E. J.** A Comparison of Methods of Estimating Sperm Concentration in Ram's Semen. *Aust. Vet. J.*, xxiv (4), 1948, 89–93.—A photoelectric method gave greater accuracy than visual methods using barium sulphate opacity standards or arbitrary "gradings".

14921. **Bennetts, W. H., Beck, A. B., and Harley, R.** The Pathogenesis of Falling Disease. Studies on Copper Deficiency in Cattle. *Aust. Vet. J.*, xxiv (9), 1948, 237–244.—The heart lesion in this disease has been shown to be a progressive myocardial atrophy with replacement fibrosis. The genesis of the myocardial atrophy is uncertain although the ætiology of the disease is severe copper deficiency.

14922. **McLean, J. W.** Lameness in Sheep Following Dipping in Rotenone Bearing Powders and Benzene Hexachloride (Gammexane). *Aust. Vet. J.*, xxiv (6), 1948, 144–147.—Symptoms of lameness developed in sheep within a few days of dipping especially when dipped in solutions in baths that had been used previously. The lameness is severe and is accompanied by heat and swelling of the lower part of one or more legs. Changing the solution after each two days of dipping prevented the occurrence of the condition.

14923. **Morley, F. H. W.** Some Seasonal Factors Affecting Fertility among Merino Ewes in the Trangie District of New South Wales. *Aust. Vet. J.*, xxiv (5), 1948, 106–111.—An investigation was carried out to determine the most satisfactory lambing time for the district on the basis of lambs surviving at weaning. September lambing was judged to be best provided protection against grass seed could be arranged and summer feed provided.

14924. **Morley, F. H. W.** The Effect of Flystrike on the Scrotum on Subsequent Fertility of Rams. *Aust. Vet. J.*, xxiv (4), 1948, 94–95.—Only one of four rams becoming fly struck during the mating season showed any apparent decrease in fertility.

14925. **Moule, G. R.** Some Aspects of the Control of Bovine Tuberculosis in Pastoral Queensland. *Aust. Vet. J.*, xxiv (1), 1948, 2–5.—Reasons are suggested for the unexpectedly high incidence of tuberculosis in three herds of beef cattle kept under semi-arid conditions in Queensland. The difficulties of controlling this disease on large cattle properties are discussed.

Evidence as to the nature of the combat-response in human beings comes from three sources:

(*a*) Study of cultures in which the concept of war and even the notion of individual conflict are unknown and meaningless—for example, in certain tribes of New Guinea, and in some original American native races;
(*b*) study of child development;
(*c*) psychopathology.

Our 'western' culture-pattern is characterized by competition rather than by co-operation. If human cultures exist in which the competitive notion is inactive, then the human being is not competitive by instinct. He learns competition, for example, in his elementary school—in the award of class marks, and in the emotions of school loyalty.

We learn many prejudices in our multitudinous behaviour-patterns, such as the only kinds of food we will agree to eat, and the manner of eating. We concentrate on certain aspects of environment and behaviour and we sharpen contrasts with other groups by means of our use of words. ('My dog and your mongrel.' 'We were maybe a bit confused; they were plainly obscurantist.') The scientific attitude to an individual of a different behaviour-pattern is: 'How interesting!' The social attitude is: 'He's different! He doesn't belong: he's wrong. How disgusting! How subhuman!' (The word *subhuman* was constantly in the German vocabulary in 1938.) Yet a study of social prejudice in schools shows that there is no social prejudice at all below the age of six to eight years (the exact age depending upon social maturity, intelligence and other factors). The sudden sharp climb which occurs with the acceptance of the verbal patterns and behaviour-patterns of adult surroundings is dramatic proof that race prejudice is learned, not instinctive.

Sociometric analysis of children by simple questions, such as asking which person they would most like to sit beside, or to take home to play after school, indicates that certain children are chosen by a lot of others, while some are completely, or almost completely, rejected. These are isolates. The isolates are maladjusted individuals in consequence, although they may not show it superficially. The psychologist would detect maladjustment through their aggressiveness. They are the haters of this world. If a child is rejected not only by his class but by his family, he becomes an extremely unbalanced adult. When the kind of behaviour which we call warfare becomes institutionalized, through our use of verbal patterns, with the idea that fighting is an institution which came down to us from heaven, then these frustrated persons become the dominant leaders. (Most of the twenty-one in the Nuremberg trial were in the class of neglected children in youth.) Such persons find expression in destroying physically what they once hated symbolically. They achieve prestige in conflict: so they take their group into war.

The roots of war are thus in individuals: they are psychological, not biological. For the abolition of large-scale human conflict we formulate three demands:

(*a*) Each child must belong to a group; the maladjusted should be noted and adjusted early;
(*b*) the child must be capable of emotionally accepting the idea that there are differences in individuals;
(*c*) child development must proceed in such a way that a stable person is produced—with a stability so high that he can accept himself with all his insecurities and frustrations.

To achieve such ends we must first establish an accepted social psychology absolutely; then we must change the ideas and understandings of peoples. The difficulty is that the change has to occur simultaneously among all peoples of the world. The social psychologist now knows many of the answers, just as the bacteriologist, the biochemist, the geneticist and the ecologist know the biological answers to the problem. It will take time, however, for the peoples of the world to accept the answers, and still more time for them to take action upon them. There are yet generations of trouble ahead for the social psychologist, and it may yet take more wars, and the help of many other branches of science, before a solution is achieved.

News

A.N.Z.A.A.S. President

At the recent Hobart Meeting of the Australian and New Zealand Association for the Advancement of Science, the retiring President, Dr. A. E. V. Richardson, was succeeded by Dr. A. B. Walkom. The Council of the Association provisionally accepted an invitation from the Government of Queensland to hold the next meeting in Brisbane, from 25 May to 1 June 1950. This arrangement is subject to confirmation as to certain practical details.

The Council appointed Professor Sir Kerr Grant, formerly Professor of Physics in the University of Adelaide, as President-Elect for the Brisbane Meeting.

Mueller Medal

The Mueller Medal has been awarded by the Council of A.N.Z.A.A.S. to Professor W. J. Dakin, who recently retired from the chair of Zoology in the University of Sydney. During the past twenty years Professor Dakin has considerably extended our knowledge of the plankton of the coast of New South Wales. This work is of fundamental importance in the problems of Australian fisheries. He has also made a close study of its plant and animal marine biology, which is to be embodied in a

book illustrated with photographs of sea-shore life. Professor Dakin has contributed to the popularization of science by his well-known broadcast talks.

The Mueller Medal has hitherto been awarded every second year: to simplify procedure, it will in future be awarded in connexion with each Meeting of the Association. It is given for distinguished work by an Australian scientist in geology, botany, zoology and anthropology.

Professor Adrien Albert

Dr. Adrien Albert has been appointed to the chair of Chemistry in the John Curtin School of Medical Research at the Australian National University. The Chemistry Division of the University will be initially located in the laboratories of the Wellcome Research Institution in London—until the main structure of the chemical laboratories at Canberra is completed. Professor Albert will then come to Australia to supervise the completion of the laboratories and the installation of equipment.

Professor Albert is 43 years of age and a native of Sydney. In 1937 he was awarded the degree of Ph.D. in the University of London for work on the acridine derivatives. From 1938 to 1947, as Research Fellow in the University of Sydney, in collaboration with colleagues in biology and bacteriology, his work included an approach to the fundamental problem of the mode of action of drugs.

Smithson Research Fellowship

Arthur J. Birch, M.Sc. (Sydney), D.Phil. (Oxon.), of the Dyson Perrins Laboratory, Oxford, has been appointed Smithson Research Fellow of the Royal Society for four years from 1 January 1949. The Fellowship is tenable at the University of Cambridge where Dr. Birch will continue his researches in Organic Chemistry.

Visit of Indian Scientists

A mission of eminent Indian scientists will visit Australia at the end of February, following the visit of the Australian delegation to India in 1948. The mission will spend six weeks visiting universities, research laboratories and industrial undertakings. The leader is Dr. S. Krishna, who is interested especially in biochemistry and forest products and is Director of Research at the Dehra Dun Institute. Other members include Lt.-Col. M. L. Ahuja, who is Director of the Kasauli Central Research Institute and has specialized in rabies and cholera; Dr. B. P. Pal, an economic botanist who is an expert on wheat rust and allied problems; V. P. Sondhi, the Deputy Director of the Geological Survey of India; and Dr. K. N. Mathur, the Assistant Director of the National Physical Laboratory at New Delhi, who is Secretary to the delegation.

Professor Z. I. Kertesz

Professor Z. I. Kertesz, of Cornell University, who occupies the chair of Chemistry at the New York State Agricultural Experiment Station, Geneva, N.Y., will deliver four Exposition Lectures for the N.S.W. Branch of the Australian Chemical Institute upon 'The Chemistry of Pectic Substances'. The lectures will be held on Tuesdays and Thursdays commencing on 22 February 1949, at the University of Sydney at 7.30 p.m. The following are the subjects:

1. Composition, molecular structure and size of pectins.
2. Detection, determination and characterization of pectins.
3. Preparation and purification of pectins.
4. Pectic enzymes.

On the following Tuesdays and Thursdays (excluding 10 March) Professor Kertesz will deliver six lectures at the Sydney Technical College in collaboration with the N.S.W. Food Technology Association, as follows:

5. The problem of protopectin.
6. Pectic substances and pectic changes in economic plants.
7. Heterogeneity problems in pectic substances.
8. Low ester pectins and their preparation.
9. Jelly grade and its determination.
10. Problems in pectin manufacture.

Professor Kertesz will also give two lectures at the Chamber of Manufactures to the Food Technology Association:

10 March.—Recent developments in the calcium firming of canned and frozen fruits and vegetables.
7 April.—Some recent technical developments in food processing research in the U.S.A.

The Night Sky in March and April

THE Equinox occurs at March 21d.09h. by Eastern Australian Time. Full Moon is at March 15d.05h. and April 13d.14h.; New Moon at March 30d.01h. and April 28d.18h. A total eclipse of the Moon on April 13 is visible in the Atlantic Ocean and the Americas and neighbouring regions. A partial eclipse of the Sun on April 28 is visible in Europe and neighbouring regions. The Moon is in conjunction with Jupiter (at 5° distance) on March 24 and April 20, and with Saturn (at 3°) on March 13 and April 9. On March 8 there is a lunar occultation of the star β Tauri, magnitude 1·8, which is visible in Melbourne between 7h.27m. and 8h.21m., p.m.

Mercury is an evening star in March, and passes through superior conjunction with the Sun on April 13 to become a morning star. Venus is close to the Sun throughout the period and changes from morning star to evening star at its superior conjunction on April 16. Mars also is close to the Sun, and changes from evening star to morning star at conjunction on March 17. Jupiter is about 3 hours ahead of the Sun early in April, and about 2 hours ahead early in May. Saturn is on the meridian at about 11.30 p.m. early in March and at about 7.30 p.m. late in April; its position among the stars becomes stationary on May 1.

National University Scholarships

Scholarships are announced, for the year 1949, to enable persons with research experience to receive further training in research methods, in connexion with the Australian National University Research Schools of Medicine, Physical Sciences, Social Science and Pacific Studies. Applicants in science should hold a Master's degree. Scholars will not necessarily be appointed eventually to positions on the University staff and they are not required to undertake to serve the University in any capacity at the expiration of their scholarships. It is expected, however, that a scholar will return to a position in Australia and scholarships are awarded on this understanding.

In the field of medical research, preference will be given to physiologists, especially those who wish to be trained in pharmacology; to bacteriologists, especially those interested in the chemical aspects of microbiology; and to pathologists interested in experimental work. The Research School of Physical Sciences will initially be engaged in research in modern nuclear physics, and preference will be given to scholars who wish to pursue studies in the related fields.

Tenure of the scholarships will be for two years, generally reckoned from the date of sailing. The living allowance for married and unmarried scholars, per annum, is respectively £A550 and £A450 in Australia; £stg.600 and £stg.450 in the United Kingdom. It is unlikely that any scholar can be financed in 'dollar' countries. An allowance up to £stg.75 each way is made towards fares, and up to £stg.50 per annum towards fees. In reckoning taxation, such scholarships are regarded as travelling allowances, so that costs of board, lodging, fees, etc., acutally incurred in fulfilling the terms of the scholarship may be deducted for taxation purposes up to the full value of the scholarship; there is also tax exemption in the United Kingdom if the scholarship is held at a university or other educational establishment. Tenure of the scholarship may be extended in approved cases.

Application forms and a statement of conditions may be obtained from the Registrar, Australian National University, Box 168, City, A.C.T. The number of scholarships to be awarded is not specified. Applications close on 15 March 1949.

Congress of Biochemistry

The first International Congress of Biochemistry is to be held in Cambridge from 19 to 25 August 1949. The initiative has been taken by the Société de Chimie Biologique and the project is approved by the International Union of Chemistry. The Congress is being organized in Sections, with respective Chairmen and Secretaries as follow:

1. Animal Nutrition and General Metabolism: Sir Jack Drummond; L. J. Harris.
2. Microbiological Chemistry: Miss M. Stephenson; E. F. Gale.
3. Enzymes and Tissue Metabolism: Prof. R. A. Peters; Mrs. D. M. Needham.
4. Proteins: K. Bailey; R. R. Porter.
5. Clinical Biochemistry: Prof. E. J. King; E. N. Allott.
6. Structure and Synthesis of Biologically Important Substances: Prof. A. R. Todd; B. Lythgoe.
7. Cytochemistry: Prof. J. N. Davidson; Miss Charity Weymouth.
8. Biological Pigments—Oxygen Carriers and Oxidizing Catalysts: Prof. D. Keilin; E. F. Hartree.
9. Hormones and Steroids: Prof. F. G. Young; F. L. Warren.
10. Chemotherapy and Immunochemistry: Sir Charles Harington; T. S. Work.
11. Plant Biochemistry: C. S. Hanes; Prof. T. A. Benn Clark.

Applications for membership of the Congress should be made to the Honorary Organizer, Francis J. Griffin, 56 Victoria Street, London, S.W.1, accompanied by a remittance of Two Pounds sterling. Accommodation can be arranged in Cambridge colleges if requested. Manuscripts of papers should reach the Secretary by 31 March 1949. Professor A. C. Chibnall is to be President, and Professor E. C. Dodds to be Chairman, of the Executive Committee.

Congress of Mathematicians

An International Congress of Mathematicians will be held in Cambridge, Mass., U.S.A., from 30 August to 6 September 1950, under the auspices of the American Mathematical Society. Information may be received from the office of the Society, 531 West 116th Street, New York City 27, U.S.A.

Elberfeld Card Index of Chemicals

A copy of the Elberfeld Index, consisting of 3,000 cards, has been sent to Australia by the Australian Scientific Technical Mission in London. It gives the chemical and physical properties, technical uses and (in particular) physiological effects on humans and animals, of a wide range of chemicals prepared and tested by I. G. Farbenindustrie, Elberfeld. The information should be of especial value to workers in toxicology and industrial hygiene.

The Index has been passed by the Division of Industrial Development to the Defence Research Laboratories, Maribyrnong, who will make it available to those interested. Enquirers may visit the D.R.L. to inspect the Index or may send or telephone the Technical Information Section, D.R.L., Private Bag No. 4, P.O., Ascot Vale W.2, Victoria; FU022, Ext. 1047.

Exchange of Publications with Germany

The Commonwealth Office of Education is seeking to make a list of institutions which are interested in establishing exchanges with Germany, and a list of publications available for such exchange, in the field of scientific, educational and cultural works, such as may further the aims of UNESCO. Any body which is able to assist should send information to the Director of the C.O.E.

'Field Crop Abstracts'

A new abstracting journal has appeared as a result of a recommendation of the 1946 Review Conference of the Commonwealth Agricultural Bureaux, whereby the information centre formerly known as the Commonwealth Bureau of Pastures and Forage Crops became the Commonwealth Bureau of Pastures and Field Crops. Abstracts of world literature on the cultivation and agricultural botany of all field crops which are grown in rotation are brought together under one cover. General sections cover land utilization and management, farming systems, machinery and equipment and the field control of weeds, diseases and pests; others deal with crop botany, physiology and biochemistry, environmental studies, taxonomy and book reviews. In the sections containing abstracts on specific crops, each crop is dealt with under headings such as agronomy, crop geography, economics of production, adaptation and variety trials.

The journal has six issues a year, the first five containing author indices and the sixth being in the form of a comprehensive index. It is issued under the title of *Field Crop Abstracts* by the C.A.B. Central Sales Branch, Penglais, Aberystwyth, Wales. Annual subscription is 35*s.* sterling, less 20 per cent. for orders placed direct.

British Council Awards

To facilitate interchange between universities in the United Kingdom and other Commonwealth countries, a number of grants towards the cost of travel are being awarded for 1949-50 to persons in the following categories:

(i) University teachers on recognized study leave;
(ii) Distinguished scientists and scholars invited by universities for short visits;
(iii) Post-graduate research workers holding research grants.

It is intended that most grants shall be under the first category. The value of travel grants from Australia to the United Kingdom and return has been fixed at £stg.150.

C.S.I.R. Studentships

Awards are being made by the Council for Scientific and Industrial Research and the Trustees of the Science and Industry Endowment Fund to enable recent graduates in science, engineering and related subjects to undertake post-graduate training overseas in subjects which would fit them to take part in the Council's research programme on their return to Australia. Each studentship is for two years and has value £A500 per annum for living in the United Kingdom or £A700 per annum for living in the United States. Reasonable fares and fees are paid in addition. In view of the dollar position, studentships tenable in the United States are being granted only under exceptional circumstances.

Holders of studentships give an undertaking to return to Australia and to enter the service of the Council for at least three years if so required. The Council gives temporary employment to appointed students who may be waiting to depart overseas.

The Antarctic Expedition

As a result of changes in plans due to the decision that the ship *Wyatt Earp* is not suitable for carrying staff and equipment to establish a shore base, the activities of the Australian National Antarctic Research Expedition for the summer of 1948-49 are restricted to the Subantarctic. The staff on Heard Island and Macquarie Island have been embarked and a new complement landed to continue the programmes of these stations for another year.

At the Heard Island station there are three meteorologists, three radio operators, three biologists, a medical officer, a diesel engineer and a cook. Cosmic ray and ionospheric observations will be continued at Macquarie Island but not at Heard Island. The Macquarie Island staff includes two biologists and a wireless operator.

Research in Anthropology

Under a grant from the Australian National Research Council, Mr. and Mrs. R. M. Berndt studied the social anthropology of Arnhem Land in 1946 and 1947. They obtained a collection of works of art and of song cycles which is now housed in Professor Elkin's department at the University of Sydney. It includes pottery which had been made in Australia by Macassars with the help of aborigines. During 1948, Mr. and Mrs. Berndt have been preparing their reports for publication under grant from the A.N.R.C.

A survey of the Wanjina cave paintings in the northern Kimberleys has been made by Mr. Harold Coate, who has recorded the related myths and comments in the native language and has provided a vocabulary of the Wunambal language. A study of the Gumbainggar language of the Clarence River and of the Bandjeland language of the Upper Richmond has been made by W. Smythe, M.B.; the former study is at present in publication.

Dr. A. Capell, of the University of Sydney, accompanied the American team of scientists to Micronesia in 1947-48, for linguistic work. He is at present on similar work in Central New Guinea at the invitation of the Administration. Professor A. P. Elkin again visited Arnhem Land in 1948 to continue his research in social anthropology in that region.

A plan submitted by the Australian National Research Council for anthropological work in Northern and Central Australia, and in New Guinea and the Islands, has been under consideration by the Australian Government for more than three years.

Personal

Professor L. H. Martin has been appointed as Chairman of the Australian Defence Research and Development Policy Committee and as Defence Scientific Adviser.

Professor V. M. Trikojus has been elected a member of the New York Academy of Science. Professor N. H. Fairley, Director of the School of Tropical Medicine in London and a doctor of both science and medicine of the University of Melbourne, has been awarded the Moxon Gold Medal of the Royal College of Physicians of England for distinguished research in clinical medicine. Dr. Lindsay Ride, who was Victorian Rhodes Scholar of 1922 and has been Professor of Physiology in the University of Hong Kong, has been appointed Vice-Chancellor of that University. Dr. Charles Kellaway, F.R.S., a graduate of the University of Melbourne, has been elected a member of the Council of the Royal Society of London.

Dr. N. A. Boutakoff, geologist to Kern Trinidad Oilfields Ltd., has been appointed senior geologist in the Department of Mines, Victoria. Professor Paul Ramdohr, ore microscopist from Berlin, will work with Dr. Frank Stillwell at the University of Melbourne on behalf of the C.S.I.R.

Dr. Edgar H. Booth, formerly of the International Wool Secretariat, has returned to Australia and is residing at Mittagong, N.S.W.

Rennie Memorial Medal

The 1948 award of the Rennie Memorial Medal, which is given for the best contribution to the development of chemical science in Australia made by a member of the Australian Chemical Institute under the age of thirty years, has been given to Dr. M. F. R. Mulcahy, Research Officer in the Council for Scientific and Industrial Research.

The Universities

University of New Zealand

In Auckland University College, the following appointments were made during 1948: G. A. Hookings and C. M. Segedin, as senior lecturers in Mathematics; Dr. C. Malden as senior lecturer in Music; R. N. Seelye and A. Odell, as lecturers in Chemistry; Dr. F. J. Godley as lecturer in Genetics; J. W. Fox as lecturer in Geography; R. M. L. Paterson as junior lecturer in Chemistry. Dr. E. M. Blaiklock has been appointed to the Chair of Classics. The following have been granted periods of refresher leave: Professors A. B. Fitt (Education) and C. G. F. Simkin (Economics); Messrs. L. H. Milliner (Botany), N. G. Stephenson (Zoology), F. H. Sagar (Physics) and C. M. Segedin (Mathematics).

In the Massey Agricultural College, I. L. Campbell has been appointed Professor of Dairy Husbandry; L. Jurd as assistant lecturer in Biochemistry and J. A. Carsiaham as assistant lecturer in Botany. Mr. W. A. McGillivray (Biochemistry) has been granted leave of absence to take up a University Research Fellowship; and A. L. Rae (Sheep Husbandry) leave of absence to take up a scholarship.

In Victoria University College, Dr. Ernest Beaglehole has been appointed to the newly created Chair of Psychology. R. S. Parker, who has recently been at the Canberra University College, has been appointed to succeed Professor Leslie Lipson to the Chair of Political Science. R. J. Munster has been appointed junior lecturer in Physics. The Vice-Chancellor of the University of New Zealand, Professor I. A. Gordon (English Language and Literature) has been abroad on university business. Leave of absence has been granted to Messrs. A. D. Monro and W. S. Medcalf (Chemistry).

At Canterbury University College, Professor N. M. McElwee has been appointed to the Chair of Electrical Engineering; W. H. Bowen as senior lecturer in Electrical Engineering; H. F. T. Adams as senior lecturer in Mechanical Engineering; M. McCaskill as junior lecturer in Geography. The visiting lecturer in Geography for the next two years is to be H. Critchfield of the State College of Washington, U.S.A.; he succeeds Dr. R. O. Buchanan of University College, London. Leave of absence has been granted to Associate Professor H. N. Parton (Chemistry); also to R. L. C. Pilgrim (Zoology) who is taking up a scholarship. At the Canterbury Agricultural College, L. F. McElroy has been appointed lecturer in Horticulture.

University of Otago

At the University of Otago, Professor R. J. T. Bell has been created emeritus professor on his retirement from the Chair of Mathematics; he is succeeded by Professor R. M. Gabriel, formerly of Cambridge, Southampton and Leeds. Professor R. Jack has been created emeritus professor on his retirement from the Chair of Physics; he is succeeded by Professor R. R. Nimmo, who was formerly of Otago, Cambridge and Western Australia, and later Nuffield Fellow and chief of research staff at Birmingham. Other appointments have included Dr. H. Bernadelli (of Frankfurt, Liverpool and Rangoon) as senior lecturer in Economics; Mrs. H. Bernadelli as assistant lecturer in Experimental Psychology; E. A. Olssen as first lecturer in Political Science; R. H. Greenwood as lecturer in Geography; W. G. Edwards and Dr. R. D. Batt as assistant lecturers in Chemistry; R. A. Wyndham as senior lecturer in Biochemistry; Dr. J. H. Stewart as assistant lecturer in Bacteriology; Dr. R. L. H. Minchin as assistant lecturer in Pathology; Dr. Irwin (of London) as lecturer in Chemistry; Dr. M. Holdsworth (of London) as lecturer in Botany; Miss B. J. McCurdy as assistant lecturer in Biochemistry in the Home Science School; D. O. W. Hall as director of Adult Education; R. W. Green as research assistant in Physical Chemistry in the Dental School.

Dr. R. S. Aitken, a former New Zealand Rhodes Scholar and recently Regius Professor of Medicine at the University of Aberdeen, has taken up his position as permanent Vice-Chancellor of the University of Otago. Exchanges of staff have been effected between

the Otago Medical School and St. Thomas's Hospital, London. Dr. A. R. Ellis, who was formerly senior lecturer in Anatomy at Otago, has been appointed Professor of Anatomy at the King Edward VII Medical School at Singapore.

Dr. Archie McIntyre, a grandson of Professor Sir Edgeworth David, has been appointed senior lecturer in Physiology. He succeeds Dr. W. V. Macfarlane, who was awarded a Nuffield Fellowship in 1948 and who has been appointed Professor of Physiology in the University of Queensland.

University of Adelaide

Mr. Eric A. Rudd, chief geologist to the Broken Hill Proprietary Company Ltd., has been appointed as the first occupant of the Chair of Economic and Mining Geology at Adelaide. Professor Rudd has had experience in petroleum exploration as well as in investigation of coal and mineral resources. He attended a post-graduate course in Economic Geology at Harvard. The new Chair, which is the first of its kind in Australia, is endowed by Broken Hill mining companies and the B.H.P. Company.

In connexion with the retirement, from the Chair of Pathology, of Professor J. B. Cleland, a fund is being raised for the painting of a portrait and the endowment of a prize. Dr. J. S. Robertson has been appointed to the Chair of Pathology in succession to Professor Cleland. Professor Robertson is thirty-three years of age and has been senior lecturer in Pathology in the University of Sydney. In 1945 he was Nuffield demonstrator in Pathology at Oxford.

University of Sydney

By means of a grant contributed equally by the Commonwealth Inter-departmental Committee on Wool and by the George Aitken Pastoral Research Trust, it has been possible to obtain the services of Dr. C. W. Emmens to take charge of the new Department of Veterinary Physiology. Dr. Emmens is a physiologist of reputation in endocrinology and was formerly of the Medical Research Council of Great Britain. The Australian Meat Board will grant the salary of a physiologist to join the staff of the department.

Dr. D. M. Myers, chief of the C.S.I.R. Division of Electrotechnology, has been appointed Professor of Electrical Engineering in succession to Sir John Madsen.

University of Western Australia

Dr. Rex T. Prider has been appointed to the Chair of Geology in succession to Professor E. de C. Clarke. Professor Prider is a graduate of the University, and was appointed to the staff of the University in 1934 after a period at Kalgoorlie. In 1936 he was awarded a Hackett Studentship.

University of Melbourne

Dr. K. F. Russell, who has been senior lecturer in Anatomy, has been appointed Associate Professor of Anatomy. Professor J. S. Turner has been elected to a Dominion Fellowship of St. John's College, Cambridge, from May 1949; he will spend about nine months in England and return through America. F. J. R. Hird, who has been Higgins Scholar since 1946, has left for England to work on plant physiology under Professor A. C. Chibnall at Cambridge. Leave has been granted to C. E. Palmer to act as scientific meteorological consultant to the United States Air Force in the North Pacific for three months.

The following appointments have been made: R. Bond as acting lecturer in Botany; D. Cochrane as senior lecturer in Mathematical Economics; Miss S. M. Fawcett as temporary lecturer in Botany; Dr. J. O. Lavarack as senior lecturer in Histology and Embryology; R. Wilson as lecturer in Economic Geography. Professor O. W. Tiegs has been elected Dean of the Faculty of Science. Recent benefactions include gifts of £50 from Dr. Salvaris and £100 from Mr. L. Rubenstein for the Department of Physiology; chemicals from Timbrol Ltd. for research in biochemistry; and £252 from the State Electricity Commission of Victoria for research work on pollen analysis of brown coal.

University of Queensland

Dr. F. W. Whitehouse, who has been lecturer in Geology since 1926, has been appointed to the Chair of Geology. Professor Whitehouse is a palaeontologist and an authority on the Queensland artesian system.

Calorimeter Building, D.S.I.R.

The Fuel Research Station of the British D.S.I.R. has designed and erected a Calorimeter Building for its research into the performances of new domestic heating appliances. It is to be emphasized that the building is not a research laboratory containing scientific instruments, but that the whole building, with its equipment, is itself a scientific instrument. It is designed to make complete and precise measurements of all of the transmission of heat in a warmed house, whether useful heat or lost. These measurements should enable the problems of domestic heating to be properly defined, so that improvements may be indicated and assessed.

The heating appliances to be tested are installed in calorimeter cabinets as in normal rooms. Each cabinet is twelve feet square and nine feet high, and each is mounted centrally in a constant-temperature chamber, twenty feet square and over twenty-six feet high. These chambers occupy the four corners of the building, which is a four-storey structure with a ground area of about 3,000 square feet. The cabinets are of quarter-inch plywood panels, covered on both sides with copper sheeting. The sheeting, on walls, floor and ceiling, is

divided into separate sections each two feet by one foot and each supplied with its own differential thermocouple so that the rate of heat-flow through the plywood can be determined at all points independently. The flow of air through the cabinets is controlled to maintain the same pressure inside as outside, and the rate of flow is recorded. The temperature of the air in the chamber surrounding each cabinet is kept constant by intake and exhaust fans, with interconnected dampers in the ducts, and provision for heating or cooling the circulating air.

The control room is on the first floor and is fifty-two feet long by ten feet wide; it is connected to each of the four cabinets by air locks. As far as possible, all of the instrument readings are automatically recorded in the control room. On the third floor, immediately above the constant-temperature chambers, are smoke-testing rooms. Chimneys, lined with stainless steel, lead to these from the cabinets and terminate in them underneath cowls so as to minimize the effects of external atmospheric changes upon chimney draughts. Smoke intensity in the chimneys is measured by a beam of light, either direct or oblique, crossing the flue between windows, to a photo-cell. The windows are heated to prevent deposition from the smoke. The photo-cells are calibrated from time to time by inserting smoke-samplers into the flues.

Heating appliances may thus be tested without their performance being affected by the measuring instruments. The tests will include variation of operating conditions and variation of fuels.

The Heating of Houses

One-third of all the coal consumed in Great Britain is used in the heating of private houses. The fuel consumption per dwelling in Britain was twice that in pre-war Germany, the inefficiency being due to chimney waste, poor wall insulation, and room draughts. There has recently been some advance in heating apparatus, as regards output from fuel con-consumed. A remarkable portion of the D.S.I.R. research into methods of improving efficiency in domestic heating, however, is a full-scale experiment upon test houses under actual living conditions. One part of the experiment comprised the use of identical heating systems in eight houses which differed only in their manner of insulation. This investigation has now reached the stage when the houses have been lived in by families for more than two years.

In the other portion of the experiment twenty houses were built at Abbots Langley in Hertfordshire, identical in design and materials, but with various heating systems. Ninety-two different appliances are being tested in them. During the first stage the houses were fully furnished but unoccupied. A team of observers simulated the occupation of each house by an identical family "X", consisting of a father, mother and two children of school age; the father had lunch away from home; special week-end diaries were planned. The lighting of stoves and fires, operation of cookers, drawing off of water, opening and shutting doors were carried out to routine.

During the winter of 1947–48 nearly 2,000 instrumental readings were taken every day. These included the various fuels, half-hourly temperatures, sunlight, winds and rates of ventilation. The first stage was completed in the spring of 1948 and the houses are now occupied by tenants. All tenants were drawn from the local Housing List and agreed to the necessary conditions imposed. They pay normal rents; they use only standard fuel supplied, and new standard cooking utensils supplied; their domestic ashes are collected for analysis. Recording instruments installed in the houses are unobtrusive and are normally read only at the weekly collection of rent; but in an emergency a request may be made for special permission to enter. The tenants are expected to lead normal lives without interference. From the information gathered in the first phase of the experiment, allowances may be made for the effects of variations from normal, as regards the composition of families (all of which have children) and their habits of living.

The experiment is an example of the application of the techniques developed during the war under the designation of Operational Research—the study of how things actually behave in practical use. The results will be available to the building industry and to the public.

Time Study in Brick Laying

It has been found that building blocks of different size and weight may be laid more speedily than standard house bricks. A work study has been made incidentally to the building of experimental houses for heating research by the British D.S.I.R., using blocks such as are actually in use in the building industry. They included blocks requiring one hand or two hands, and blocks requiring two men to handle. Separate time recordings were made of unit operations such as spreading mortar, plumbing and cutting, totalling over 200,000 observations. Analysis of the records, which were made continuously throughout the working day for six months, showed an experimental error of less than 5 per cent., based on a 99 per cent. confidence limit.

The results were well defined and showed wide differentiation between the various blocks. The slowest were the common house bricks, which took four times as long to lay as the same volume of concrete blocks. For a one-man lift, time saved increases until the size of the block reaches that of twelve bricks; beyond that two men would be required to lift.

The investigation concerned speed and not cost, which depends upon the relative local price of concrete. Under all conditions observed

the non-productive time was much in excess of the productive time of the workers, and much of the non-productive time could be eliminated by organization. To a lesser extent economy could be gained by improvement in methods, for which the study included time-analysis of the tasks incidental to the block laying, such as measuring detail and erecting doors and windows. (D.S.I.R. Technical Paper No. 1. National Building Studies—*A Work Study in Block Laying*. H.M.S.O., London, 1948. Price, 1*s*. 6*d*.)

Building Bricks

The British D.S.I.R. has issued advice upon the manufacture, properties and appropriate uses of *Sand-Lime Bricks*. (Special Report No. 3, National Building Studies. Price, 1*s*. 3*d*.) Guidance is given to manufacturers upon choice of raw materials and precautions in manufacture. In the account of the use of the bricks it is noted that a cement-lime-sand mortar is more suitable than cement-sand mortars. Carvings in low relief have been made on sand-lime bricks, for example by Eric Gill upon the wall of the Mond Laboratory at Cambridge.

A bulletin upon *Clay Building Bricks* has been prepared by the D.S.I.R. for the architect, manufacturer and builder. (Bulletin No. 1, National Building Studies. Price, 1*s*.) The attention of the manufacturer is called to the availability of technical information that would enable savings in fuel and labour. Tests are described for strength, permeability, conductivity, weathering resistance and soluble-salt content. The bulletin points out that in many particulars the limitations of test data require that special attention should be given to design and planning.

Wood Bending

The Forest Products Research Board of the British D.S.I.R. has studied the theory and practice of the bending of wood for more than fifteen years and has now issued a book on the subject, *Solid and Laminated Wood Bending*. (H.M.S.O., 1948. Price, 5*s*.) It contains the result of laboratory research together with experience gained from contact with makers of furniture, sports goods, aircraft, boat builders and other users of bent timber. In the section on solid bending there are five chapters upon the selection and preparation of material, softening treatments, the making of various shapes and the retention of shape. Other chapters cover laminated bending, including selection of laminae and glues, and methods of accelerating the setting.

Although the book is essentially a manual of practice, the final chapter gives such theoretical background as suffices to explain the adoption of the various procedures.

Frozen Food Research Coordination

A consultative group of research organizations in frozen food has been formed in Great Britain under the chairmanship of Dr. Franklin Kidd, F.R.S. Its object is to exchange information informally upon current research into quick freezing processes, especially to prevent overlapping and to discover gaps in programmes. The institutions in the group include the Low Temperature Research Station, Torry Research Station and Ditton Laboratory of the D.S.I.R., together with the Research Associations in food industries, packing and baking, and the Ministry of Food and the Fruit and Vegetable Preservation Research Station. The Secretary is P. R. P. Claridge. Food Investigation Organisation, Lloyd's Bank Chambers, Hobson Street, Cambridge, England.

Aluminium in the Food Industry

Although aluminium is inherently a very reactive metal, it is able to resist corrosion because of the highly protective film of oxide which normally coats it. Information and research upon the reactions between aluminium and its alloys with various food substances have been collected by the Low Temperature Research Station of the British D.S.I.R. and published as *Food Investigation Special Report No. 50* (H.M.S.O., 1948. Price, 3*s*.). Fundamental research included the action of simple aqueous solutions such as acids, salts and inhibitors, in relation to the structure and composition at the surface.

There is no evidence that any properties injurious to health are imparted to foods which have been cooked or held in aluminium vessels; no acceleration of the destruction of vitamins appears in cooking; no catalysis of the oxidation or rancidity of fats; no effect upon the fermentation of yeast. The effects of food products upon the aluminium itself are considered in great detail in the report. The last portion discusses the various methods of protection, such as by oxide coatings, metallic coatings, cathodic protection, paints and lacquers.

New Steel Process

A new process of making steel has been developed by the Iron and Steel Research Association, which is sponsored by the whole industry. It consists essentially in the introduction of oxygen to the air blast of the converter. The results are a 50 per cent. increase in output, more flexibility of control, higher quality steel and the use of a greater proportion of scrap. In tests in a Leeds foundry the oxygen process produced a batch of steel in eight minutes compared with fifteen minutes by former methods. About 45 per cent. of the 400,000 tons of liquid steel produced in Britain annually for castings is made in plant to which the oxygen method can now be applied.

Food Investigation Board, D.S.I.R.

The British D.S.I.R. has issued its first report since 1938 upon work done in food investigation. The type set for the 1939 report was destroyed by enemy action. Even the short-

range research of directed character which occupied the Board during the war (such as on methods for disintegration) produced some fundamental discoveries. One of these was the reversible formation of starch from a form of simple sugar: the study of the reaction revealed the mechanism whereby the chain molecules of starch and related polysaccharides are built up from glucose units.

Work begun in 1946 included chemical analyses upon the various meat tissues, in a broad attack upon the problem of quality; collaboration with the Agricultural Research Council upon potato problems; preservation of fruit by oily or waxy 'skin coatings'; the salt-curing of herrings and the utilization of fish in dried form suitable for export. It has been found possible to express in a single set of curves the correlation between the proportions of the main constituents of meat animals and their variation during the growth of the animal and from breed to breed and species to species. (*Food Investigation*, 1940–1946. Annotated with references to all of the 223 papers published by members of the staff in the period. H.M.S.O. Price, 9*d*.)

Aluminium Bridge

The world's first movable bridge of aluminium alloy has been constructed at Sunderland, England. It is of bascule (levered drawbridge) type, 90 foot span, to carry full road and rail traffic. The total weight is 54 tons: the decrease in dead weight, compared with steel, radically affects design. It also decreases the power and time needed for the raising of the bridge, which is effected by a motor of 20 horsepower in less than 75 seconds. Incidentally, the use of aluminium saves steel at a time of shortage.

Industrial Research in Britain

The Government of the United Kingdom is allotting £2,500,000 for industrial research in 1949, compared with £470,000 a year before the war. The number of research associations has risen to 38 from 21 in 1938, and is still increasing. Some notable recent results include the firing of pottery in two days instead of eight; and a domestic fire grate with a heating efficiency of 37 per cent. with coal and 48 per cent. with coke, compared with 25 per cent. in existing domestic grates. The use of infrared radiation has reduced the drying time of adhesives and paint (in the boot industry) from two hours to two minutes. Iron foundry output has increased from 2½ million tons pre-war to 3½ million tons; while a new product known as 'nodular cast-iron' has been developed with great shear strength and will be a suitable article for export.

London Institute of Ophthalmology

An amalgamation has been effected between the medical schools of three London hospitals to form an institute specializing in optical diseases, for training in medicine and surgery. It forms one of the federated institutes of the British Post-Graduate Medical Federation of the University of London. The new institute was opened in November, 1948.

County Colleges

Thirty-four colleges are being established in the London area for boys and girls under 18 years of age who have left school for work. Each will take 2,500 pupils, in groups of 500, on a one-day-a-week basis. All boys and girls under 18 years who are not attending school full-time must take compulsory courses at these County Colleges (including social studies, physical education and English) for 44 weeks of each year. The typical college includes an assembly hall, boys' and girls' gymnasia with changing rooms and showers, library, classrooms, office and staff accommodation, bookstall and enquiry counter; with two acres of ground.

Nylon Bandages

Research on plastic dressings for wounds has been carried on at the Birmingham Accident Hospital under the sponsorship of the British Medical Research Council. The aim has been to allow moisture to escape from the wound and the skin while preventing the entry of liquids and germs. Experience in clothing troops in the tropics during the war showed that certain fabrics would allow the passage of water vapour (perspiration) but not of liquid water (rain). A wound dressing, however, must be capable of quick and complete sterilization, whether by heating or by antiseptics.

The new dressing is of nylon film—not woven from fibres, but a uniform sheet. It fulfils the requirements mentioned and has the advantage of being transparent, so that the progress of a wound may be inspected without disturbing it.

Moth Proofing

Moth grubs are able to digest wool by breaking down one of the linkages of the wool molecules. The new moth-proofing process developed in the United Kingdom changes the disulphide links so that the grub cannot digest them. The treatment is thus of permanent character, withstanding heat, washing and time.

University Awards in Britain

A Working Party, comprizing the universities, local education authorities, the Ministry of Education and other bodies, was established in the United Kingdom in 1948 to consider what measures should be taken to ensure that the increased number of places at the universities would be filled to the best advantage. The Report of the Working Party suggests that 11,000 students should receive aid from public funds each year out of a total of 18,000 students at the English and Welsh universities. These awards would include 2,000 State Scholarships; 2,000 allowances from the Ministry concomitant with local entrance scholarships and exhibi-

tions; 7,000 awards from local authorities. It is recommended that the system of awarding help on condition of entering the teaching service should be abolished. The 7,000 remaining places at the universities would be divided among students from overseas, students with grants from other bodies, and students without financial help. It is recommended that normal rates of grant should be extended to cover university Vacations as well as Terms, and that the ceiling of the scale for calculating contributions from parents should be raised to £2,000. It is also proposed that State Scholarships should be tenable at universities within the Commonwealth and in foreign countries.

The Scientific Societies

Royal Society of New South Wales

December: R. Brewer, Mineralogical examination of soils developed on the Prospect Hill intrusion, N.S.W.
J. A. Dulhunty, Relations of rank to inherent moisture of vitrain and permanent moisture reduction on drying.
F. P. Dwyer and H. N. Schafer, The chemistry of bivalent and trivalent rhodium. XI: The potential of the trivalent quadrivalent rhodium couple in sulphuric acid.
F. N. Hanlon, Geology of the North Western Coalfield, N.S.W. VII: Geology of the Boggabri District; VIII: Geology of the Narrabri District.
G. D. Osborne, Note on the occurrence of tridymite in metamorphosed Hawkesbury sandstone at Bundeena and West Pymble, Sydney District, N.S.W.
G. D. Osborne, A. V. Jopling and F. W. Lancaster, The stratigraphy and general form of the Timor Anticline, N.S.W.
N. C. Stevens, Geology of the Canowindra District, N.S.W. I: Stratigraphy and structure of the Cargo-Toogong District.

Victorian Society of Pathology and Experimental Medicine

December: S. Fazekas de St. Groth and M. Gilpin, The protective value of vaccination against influenza.
A. H. Ennor and L. A. Stocken, The estimation of creatine and creatinine.
J. L. O'Connor, Observations on the viruses of Varicella and of Herpes Zoster.
H. F. Bettinger and I. O'Loughlin, Pregnancy test using the male toad.
G. Christie (demonstration), Intravascular clotting.

Royal Society of Western Australia

December: C. A. Gardner, Some rare Western Australian Plants recently rediscovered.
L. Glauert, Some curiosities in Natural History.
R. W. Fairbridge, Cuttle fish.
C. F. H. Jenkins, The Jarrah leaf miner.

Royal Society of Victoria

December: J. E. Bradley, Tides of Hobson's Bay.
E. D. Gill, Description and biological interpretation of some Victorian Hypostomes.

Royal Society of Queensland

October: O. A. Jones, Impression of travel abroad.
November: I. M. Mackerras (memorial lecture), Alfred Jefferis Turner and amateur entomology in Australia.

Royal Society of Tasmania

October: W. H. Hudspeth, The rise and fall of Charles Swanston of the Derwent Bank.
G. K. Meldrum, Clover and infertility in sheep.

Book Notices

ELASTICITY OF WOOD AND PLYWOOD. D.S.I.R., Forest Products Research, Special Report No. 7. By R. F. S. Hearmon. (London: H.M.S.O., 1948. 87 pp., 37 text figs., bibl. 6″ × 9½″.) English price, 2s.

A summary of information for the research worker and designer, including a number of new results from the F.P.R. Laboratory. Part I deals with the mathematical theory and methods of measurement of the nine independent elastic constants of wood; the effects of temperature, moisture, grain angle and shear extension coupling. It excludes strength properties such as fatigue, impact and ultimate strength. Part II deals with the elasticity of plywood, relating it to the constituent woods and forms of construction of the ply. Part III deals with the buckling and deflexion of plywood plates, the buckling of plywood cylinders and the frequency of vibration of plates. Most of the work covered by Part III was done in America and Australia during the period 1939-1945 and much of it has previously appeared only in Australian reports which are generally inaccessible.

FOOD PRODUCTION AND THE CONSUMPTION OF FOODSTUFFS AND NUTRIENTS IN AUSTRALIA. Report No. 2 of the Commonwealth Bureau of Census and Statistics. By S. R. Carver. (Canberra, 1948. 40 pp., 37 tables, foolscap typescript, paper covers.)

A comprehensive review of food production and of the consumption of foodstuffs and nutrients in Australia for the year 1947, with comparative data for the previous periods back to 1936. Allowing for foodstuffs exported overseas and for foodstuffs put to industrial or other non-food uses, the report enables estimates to be made of the quantities available for human consumption in Australia.

It is noted that particulars in respect of glucose and breakfast foods from maize and rice are concealed as confidential. The section of the report which deals with the level of nutrient intake in Australia was compiled under the direction of Dr. F. W. Clements, Chairman of the Nutrition Committee. It does not attempt to compare Australian figures with standard dietary requirements, chiefly because much work has still to be done to establish human requirements for certain of the nutrients, such as vitamin A, riboflavin and niacin. The analysis, however, does indicate a deficiency in calcium intake, leading to the conclusion that milk consumption in Australia could be increased with benefit to health and nutrition. There has not been any significant change in the intake of any nutrient in the past ten years.

Similar reports will follow at six-monthly intervals.

THE NATURAL LIGHTING OF INDUSTRIAL BUILDINGS. Part 2, Factory Planning. Australian Department of Labour and National Service, Industrial Welfare Division, Bulletin No. 11, 1948. (83 pp., 44 photographs, 17 diagrams, many text figs. 7″ × 9½″, paper covers.) Price, 2s. Obtainable from the offices of the Department in each capital city.

The earlier part of this report, previously published, dealt with aspects of the measurement of natural lighting and with relation of actual measurements of illumination in buildings to values predicted by medium of a factor deduced from the design plans of the buildings. The present report describes standards of natural lighting considered to be economic, and provides simple practical methods by which they may be achieved, to replace customary rule-of-thumb methods.

Although much had been done overseas, there were no Australian standards of natural lighting design or performance; no recording of outdoor illumination in Australia or even meters capable of recording its higher values. Particular attention has been given to the saw-tooth roof, which is so common in Australian factories. Weaknesses revealed in lighting and ventilation performances raise the question of whether the saw-tooth roof is suitable for first-class industrial buildings not needing lighting for particular processes. Daylight-factor protractors, which enable lighting performance to be predicted from design plans, have been secured from the English D.S.I.R. and are available at low cost. The Bulletin contains various diagrams to aid scientific design, including sunlight penetration diagrams for the several capital cities of Australia. The investigations of the Department show that standard natural lighting can be obtained in Australia for ninety per cent. of the year.

Lighting investigations have been accompanied by investigation of natural ventilation, using suction and pressure forces created by the wind, rather than convection currents. It appears that standard ventilation also (fifteen changes per hour) can be obtained by natural means in a suitably designed building (in Melbourne) for ninety per cent. of working time. The Industrial Welfare Division is proceeding with study on meteorological conditions in Australian industrial areas; on the influence of thermal and atmospheric conditions on human beings at work; and on the creation of internal air movement by utilization of external wind forces. Results will be published in a further Bulletin.

STRUCTURAL REQUIREMENTS FOR HOUSES. D.S.I.R. National Building Studies, Special Report No. 1. By F. G. Thomas. (London: H.M.S.O., 1948. 9 pp., with 8 pp. of plates. 6″ × 9½″.) English price, 9*d.*

Traditional brick and stone houses were built for weather resistance and thermal insulation, without concern as to the load supported by the walls. Many new and unconventional forms of construction have been introduced to meet the present demand for houses. They consist essentially of protecting walls and roof, together with floor-loading, hung upon some form of structural framework. It is economical to reduce the strength considerably below that of brick houses. The D.S.I.R. Building Research Station has made standardized tests upon full-scale models. The Report describes the acceptance standards finally adopted for static and impact strength and for stiffness; it gives figures for typical floor and roof loadings, snow and wind loadings, and is well supplied with photographs.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

The Composition of the Ethyl Ester of Sodium Formyl-Acetate

Since Piutti (1887) and Wislicenus (1887) first studied the products of condensation between ethyl-formate and ethyl-acetate in the presence of metallic sodium or sodium ethoxide, numerous workers have been trying to isolate and purify the expected ethyl-formyl-acetate. It was, however, soon recognized that the free formyl-acetic ester is too reactive to be isolated as such, and so the endeavour of the later workers was directed towards the preparation of its sodium derivative. A few years after his original discovery, Wislicenus (1901) pointed out that the percentage of sodium in the compound was too high for the presumed formula, $NaOCH{=}CHCOOC_2H_5$ (or, $OHC\text{-}CHNa\text{-}COOC_2H_5$). Numerous attempts to purify the compound proved unsuccessful. Even as late as 1941, Cogan asserted the presence of sodium formate and sodium aceto-acetate in the sodium derivative of ethyl-formyl-acetate. This was recently contradicted by McElvain and Clark (1947), who were not able to find any aceto-acetic ester in a product prepared essentially according to the procedure suggested by Cogan.

In connexion with a comprehensive study concerning the optimum conditions for the preparation of sodium-formyl-acetate we have been able to establish its composition as corresponding to the formula $NaOCH{=}CHCOOC_2H_5.C_2H_5ONa$. This explains the high percentage of sodium as found by most researchers on the subject. In more than ten different preparations, obtained in different solvents (ether, benzene) with different condensing agents (sodium, sodium ethoxide), we were able to establish that the sodium derivative, isolated and purified by trituration with ether, corresponds to the following analytical composition: Found Na, 21·5 to 22·5 per cent.; C_2H_5O- (determined as C_2H_5OH according to the method of W. M. Fischer and A. Schmidt (1924, 1926), 42·2 to 45·0 per cent.; $OHC\text{-}CH_2\text{-}COOC_2H_5$ (determined as its condensation product with aniline), 64·5 to 66 per cent. For the formula $NaOCH{=}CHCOOC_2H_5.C_2H_5ONa$, the figures calculated are: Na, 22·3; C_2H_5O-, 43·6; and $OHC\text{-}CH_2\text{-}COOC_2H_5$, 66·5 per cent.

The possibility of improving the preparation of ethyl-formyl-acetate, and details of the analytical methods employed, will be discussed in a forthcoming publication.

HENRYK SILBERMAN,
SOFIA SILBERMAN-MARTYNCEWA.

University School of Agriculture,
and Andrews' Laboratories,
Sydney.
26 October 1948.

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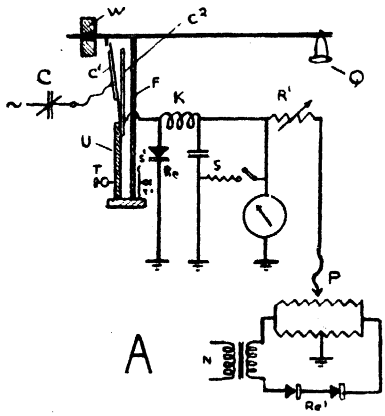
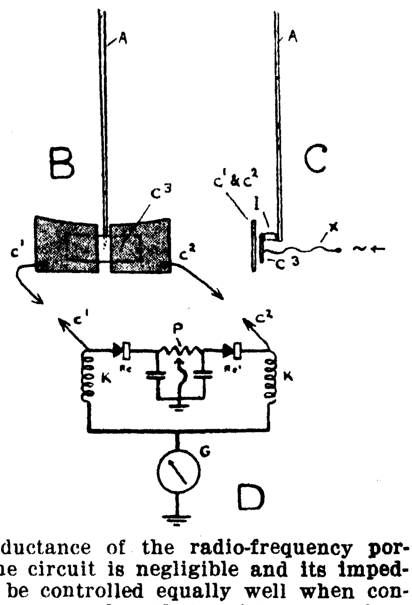
Rectified Radio-Frequency Applications

When titrations are carried out with a radio-frequency oscillator and a conductimetric tube by the author's rectified radio-frequency method (Blake, 1947), the meter readings are mainly dependent upon the capacitance and resistance of the radio-frequency circuit. The former remains constant while the latter will vary in accordance with the conductance of the solution with which the conductimetric tube is filled (Blake, 1948).





The inductance of the radio-frequency portion of the circuit is negligible and its impedance can be controlled equally well when conditions are reversed so that resistance is given a constant value and capacitance varied. The rectified radio-frequency circuit described (Blake, 1947) should, under this reversal, find application for other scientific purposes. Thus, the author has designed a simple chemical balance which has proved useful in conjunction with the rectified radio-frequency titration apparatus used when compounding solutions of various reagents. It is designed to operate from the same radio-frequency oscillator; it is sufficiently sensitive for preliminary weighing prior to final matching against standard samples (Blake, 1948).

The balance, Figure A, is based upon the lever arrangement employed by Whiddington (1921) for his heterodyne measurements of small physical quantities. The present method, though much less sensitive than that of Whiddington, has the advantage of simplicity; as it is at least as sensitive as the average chemical balance, it is suitable for the purpose suggested. F is a strip of a resilient insulating material such as bakelite; C^1 and C^2 are two plates which form a small variable condenser. The former, C^1, approximately 4 cm. × 2 cm., is fixed in an upright position on a support, U, which can be deflected slightly from the vertical by a thumbscrew, T: this adjustment is used when setting the sensitivity of the balance. The latter, C^2, approximately 3 cm. × 2 cm., is attached to a small piece of drawing paper coated with shellac varnish, which acts as a suitable hinge and at the same time functions as an insulator between the condenser plates, preventing them from touching one another: it also serves to damp the movements of F.

When a weight, or a quantity of the substance to be weighed, is placed in the pan Q, the plate C^1 of the condenser is made to approach nearer to C^2, thus increasing the capacity. The balance is connected in circuit as indicated in the figure. W is an adjustable counterweight; the thumbscrew T′ and spring S′ limit the displacement of F from the vertical.

A Differential Circuit for Recording the Movements of a Standard Chemical Balance

Figures B, C, D show the arrangement of a circuit similar to that employed by the author's radio-frequency solution comparator (Blake, 1948), which enables the movements of the indicating pointer of an ordinary chemical balance to be reproduced as galvanometer deflections. In Figures B and C, the indicating pointer of the balance is at A; a small aluminium plate, C^3, is attached to it and insulated from it by an insulator, I. Close to and in front of C^3 are two slightly larger plates C^1 and C^2; the electrical circuit is similar to that given previously by the author (Blake, 1948). Plate C^3 is connected to the oscillator by an extremely fine flexible wire, X. The two metal rectifiers, Re and Re′, are connected in opposition to one another and are also connected to a micro-ammeter or galvanometer, G, as shown in Figure D.

The opposing voltages are brought to balance by means of a potentiometer, P, while the indicating pointer is in the central position on its scale, i.e., when the pans are balanced. When a weight is placed on a pan, the displacement of the indicating pointer to either

side will then register as a galvanometer deflexion. The whole of the radio-frequency portion of the circuit, and the lead from the oscillator, are of course suitably screened.

The Differential Rectified Radio-Frequency Circuit used to Displace the Optical lever System of Blake's ebonite radiometer

An arrangement similar to that shown in Figure A can be used in place of the optical lever system for recording the small movements of the ebonite strip in the author's radiometer (Blake, 1944); alternatively, the differential circuit may be used. Either circuit is easily adaptable for use with many other measuring or recording devices, relay operations and the like, where very small mechanical movements require translation into electrical impulses.

G. G. BLAKE.

School of Physics,
University of Sydney.
16 November 1948.

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Trans-Tasman Lower Devonian Correlation

Professor Robin S. Allan (1947) recently described a new genus of strophomenid brachiopod from the Reefton Beds (Lower Devonian) of New Zealand, which he called *Maoristrophia*. At that time, the only species known was the one on which the genus was founded. It is therefore of considerable palaeogeographical interest that this new genus has now been discovered in Australia. Three new species have been determined—one from Lilydale, Victoria (at three different localities), and two from the right bank of the Little Henty River about one mile south-east of Zeehan, Tasmania. Poorly preserved specimens of *Maoristrophia*, which do not lend themselves to specific determination, have been collected from the Lyell Highway about twelve miles east of Queenstown, Tasmania.

EDMUND D. GILL.

National Museum of Victoria.
16 November 1948.

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Views

Science and Human Conflict

The A.N.Z.A.A.S. Conference this month held a discussion on the question, 'Is there a scientific approach to problems of human conflict?'.* As, unfortunately, little time was available for active participation by the audience, I suggest that the discussion might be continued in *The Australian Journal of Science*.

My chief criticism of the discussion is that, in spite of the ability of the two main speakers, we did not hear a scientific approach to the problem of human conflict as a whole. We heard instead an approach by scientists who were specialists in particular fields of science, and who tried to see how far they could apply their own specialized knowledge to certain aspects of a different field. The degree to which they were successful varied with the closeness of their particular fields to human problems. Professor Burnet's immediate extrapolation from the henyard to human society was obviously unwarranted, whereas Professor Oeser was able to deal with some actual human problems. In both cases the method of approach limited the speakers to the fringe of the main subject, and no attempt was made to determine the relative importance of the various causes of conflict. Admittedly it might have been difficult to find speakers to make a unified approach to the whole problem, but the attempt should have been made.

This compartmentalized approach can only lead to the type of unbalanced conclusion which is responsible for the public opinion, that scientists outside of their own particular fields are unpractical idealists. No one can dispute that the psychological causes of conflict discussed by Professor Oeser are important, but are they of major importance? It is unreasonable to ask ourselves only why people are willing to fight (physically or otherwise); we must also ask what they fight about. The most unaggressive man will fight if he has sufficient reason. We must also ask what are the material forces which compel men to fight, even if they do not wish to do so. The importance of these can be seen by considering the controls exercised by any government during a war.

We should, of course, reform education and mental environment as suggested by Professor Oeser. We should begin at once; but it will be a long job. The conflicts which overshadow us at present threaten so imminent a destruction that they must be examined and resolved by the most direct methods available. While I do not deny the importance of the psychological issues, it seems to me that we can obtain more immediate results by examining the material causes of human conflict.

In conclusion, may I make a plea for a further development, at the next A.N.Z.A.A.S. Conference, of the very important beginning represented by this discussion. A fuller discussion should be arranged, with more time for audience-participation (and more space for their accommodation). Possibly a whole day could be devoted to the subject. The organizers of the Hobart Conference are to be congratulated on taking this very important step, but it should only be regarded as a beginning.

K. RACHEL MAKINSON.

National Standards Laboratory,
Chippendale, N.S.W.
19 January 1949.

* This JOURNAL, *11*, 125.

Reviews

Biological Growth

GROWTH IN RELATION TO DIFFERENTIATION AND MORPHOGENESIS. Symposia of the Society for Experimental Biology, II. (Cambridge: University Press, 1948. 365 pp., numerous text figs. and tables. 6¼" × 9¾".) English price, 35*s*.

The multicellular organism normally starts its life as a single cell, the product of fertilization. This cell contains a nucleus of a definite gene-constitution, which is surrounded by cytoplasm, also of a particular character. Subsequent growth involves not only cell-division and an increase in size, but also differentiation, in which cells develop in different directions into distinct tissues and organs. With few exceptions, however—and these in no way invalidate the generalization—the nuclei of all the cells comprising the organism may be assumed to have an identical gene constitution. If then the potential and actual development of the cell is controlled by its genotype, how does this differentiation (which must be considered ultimately at the cellular level) come about? How and why does the same gene complex act differently in different cells of the body, and how are these various results coordinated to give a workable whole? This process of epigenesis has become one of the central problems of modern biology, by reason of its importance and absorbing interest. Its attack is demanding the use of all available disciplines—biochemistry, physiology, cytology, genetics and embryology among others—and at the same time it is bringing about a coordination of these disciplines into one biological whole which could scarcely have seemed possible a decade ago. In particular, it is bringing the problems of the geneticist into this unity from a previously rather isolated consideration of the hereditary mechanisms of gene transfer.

The book under review, which is the successor to the now well-known volume on *Nucleic Acid*, published by the same Society, is concerned largely with this problem of differentiation and epigenesis. It contains nineteen papers, and all of the authors may claim leading positions in their respective fields. In the majority of the articles there has been an emphasis on generalizations and explanatory hypotheses, even to the point of speculation, rather than on factual data. Since the various contributions are based on observations of diverse biological materials and the authors have carried out their work from different premises and with different objectives, the existence of some diversity of opinion is not unexpected. More surprising, perhaps, is the extent of conformity in the various hypotheses developed. As a consequence the book in general gives the impression not only of a unification of biology, but also of the basic soundness of these hypotheses. The reader is impressed with the academic value of the work, and with its potential value in leading to a better understanding and control of biological growth in many applied fields, not excluding the etiology of human hereditary diseases and of malignancy.

Of the nineteen papers, eight deal with strictly botanical matters. A group of three papers by F. G. Gregory, K. C. Hamner and R. Harder are concerned with the induction of flowering and reproductive structures in higher plants and with the control of this development by hormone systems dependent upon photoperiod and other environmental conditions. F. J. Richards deals with the origin of phyllotaxis; another group of three papers by E. Ball, Mary Snow and R. Snow, and C. W. Wardlaw are concerned with problems of tissue differentiation and induction, a field in which animal embryologists seem to be well ahead. Wardlaw's contribution, 'Experimental Morphology with Special Reference to Pteridophytes', in particular, emphasizes the need for a knowledge of the nature of gene action in cell differentiation. The article by Heath and Holdsworth is concerned with the effect of photoperiod on hormone systems in the onion plant and with the consequent hormonal control of development, and might well have been grouped with the articles of Gregory, Hamner and Harder.

Of the other papers, seven deal with zoological subjects, and three are of a general nature. The final article, by J. H. Woodger, treats of embryology from the logician's viewpoint, and discusses the building up of the science—the body of which consists of observation, generalizations and hypotheses of various orders. Emphasis is placed on the importance and value of the higher orders of hypothesis, termed 'key hypotheses', and their susceptibility to confirmation and verification. This logical treatment is, of course, applicable to other disciplines than embryology.

V. B. Wigglesworth, in the first article, considers the role of the cell in determination. Competition between cells for hormones and inductive substances is subordinated to a concept of the organism as a self-regulating chemical continuum. J. Holtfreter's article, which is in logical sequence, builds up a speculative but impressive thesis on embryonic induction involving inductive and morphogenic substances in the cytoplasm. These substances are assumed to occur in the basophilic granules (microsomes) of the cell cytoplasm, which Claude and Brachet have shown to be nucleoprotein in nature. The thesis seems compatible with the plasmagene concept and with the concept of the enzymatic control of the cytoplasm as developed by Spiegelman in a later article in the book.

C. H. Waddington, dealing with the genetic control of development, approaches the subject from the angle of the experimental embryologist. Differentiation is regarded as due to

the synthesis of different types of cytoplasm, beginning with enzymatic differences, but self-reinforcing, and leading to inevitable canalization and irreversible specialization. Although he postulates an autocatalytic phase in the cytoplasm, he is chary of assigning to cytoplasmic granules the full gene-like capacities of self-perpetuation and mutability of Darlington's plasmagenes. H. Gruneberg, well known for his work on the genetics of the mouse, contributes a paper on 'Genes and Pathological Development in Mammals'. In a discussion of the analysis of gene-controlled processes he develops his earlier thesis of the unitary nature of primary gene action, affirming that the apparent pleiotropism of many mammalian genes is due to coördinated or subordinated (indirect) effects. Hadorn then develops a concept of phase specificity in gene action, particularly with reference to the action of lethal factors in *Drosophila*. This phase specificity may often be more apparent than real, since the final lethal result may occur at some normal crisis in the life cycle, and does not necessarily coincide with the period of physiological activity of the gene.

The article on 'The Nucleus and Cytoplasm in Differentiation' by K. Mather explains the dependency of the cytoplasm on the nuclear genes in terms of substances which are produced by the genes and pass into the cytoplasm. Cell behaviour is claimed to depend immediately upon the constitution of the cytoplasm with its permanent plasmagenes and the gene products derived from the nucleus, but the ultimate control is entirely nuclear. The existence of a lag in the modification of the cytoplasm by the nucleus, which may extend from one to many cell generations, is considered to provide possibilities for a progressive change in the cytoplasm whilst the nucleus remains constant. This will permit cell differentiation.

The article by S. Spiegelman on 'Differentiation as the Controlled Production of Unique Enzyme Systems' provides an outstanding and, as a whole, logically satisfying hypothesis concerning the nature of gene action and differentiation at the cell level, and develops the plasmagene theory to a point where it gives a unification of the problems of classical genetics, cytoplasmic inheritance, cellular differentiation and enzymatic adaptation such as is found in the yeasts and bacteria.

Although much of the speculation in many of the articles may be proven incorrect in the future, it can only serve as a stimulus to present research, and the book should be read by all biological research workers and advanced students. The format and printing of the book follows that of Volume I of the Symposia of the Society for Experimental Biology, and the various papers are adequately illustrated by diagrams and plates. Lists of references are given at the end of each article.

S. Smith-White

Agriculture

New and Promising Varieties Recently Described in the Literature, 7th issue. (Commonwealth Bureau of Plant Breeding and Genetics, 1948. 44 pp.) From C.A.B. Liaison Officer, 314 Albert Street, East Melbourne, C2. Price, 3*s.* 2*d.*

This publication presents, in tabular form, information as to agronomic characteristics, disease resistance and general adaptation of new and promising varieties of cultivated plants which have been recently described in the literature. Wheat, oats, barley, rye, maize, sorghum, rice, herbage grasses and legumes, root, vegetable and fibre plants, sugar cane, tobacco, hops, pepper and fruit crops are included.

The material is based almost entirely on records in Volumes 15 to 17 of *Plant Breeding Abstracts*. References are quoted, together with the names and addresses of the institutions and organizations from which further information may be obtained. Australia's contributions are restricted to several wheat varieties with one flax and one cotton entry.

H. C. Trumble.

Genetics

The Genetics of Garden Plants. By M. B. Crane and W. J. C. Lawrence. (London: Macmillan and Company Ltd., 1947. 299 pp. 67 figs. 6″ × 8⅜″.) English price, 16*s.*

The development of genetical science has been intimately connected with the study of garden plants ever since Mendel carried out his classical experiments in the monastery garden at Brunn. Our cultivated plants give us the best demonstrations not only of the more complex effects of polyploidy in fertility and sterility, but also of the simple gene segregations on which the chromosome theory of heredity is based. All these and many other genetical facts and theories are profusely illustrated in Crane and Lawrence's well-known book. In this its third edition, it has been brought up to date in several minor respects. For example, the sections dealing with the induction of polyploids and with incompatability relationships in fruit trees incorporate new data. Fundamentally the book remains its old useful self and will continue to be of value to the practical horticulturist interested in breeding new and improved varieties of garden plants as well as to the university student in botany or agriculture.

H. N. Barber.

Mathematics

Operational Methods in Applied Mathematics, 2nd edition. By H. S. Carslaw and J. C. Jaeger. (Oxford: University Press, 1948. 359 pp.) English price: 20*s.*

There are heretics in mathematics as well as in religion. Sometimes the heresy becomes orthodoxy: the work of the younger French mathematicians at the turn of the century, which so disturbed Hermite, is now part of the

received tradition; the ideas of Peano, which Poincaré criticized so adversely, are now (with much of his notation) used by many to whom he is but a name.

Heaviside, whose methods of solving differential equations are explained in the book under review, was a born heretic: he always wanted to contradict something. He suggested a system of electromagnetic units, different from that accepted, which (though it is useful in some work) has not the universal fitness he claimed for it. He used divergent series in the days when Abel's opinion—that they were the invention of the devil—was universally held. They are now used with the necessary restrictions which Heaviside would have scorned. He was, like Gibbs, an early advocate of vector methods: the battle in this field has been won, though not all of his symbols are in use—while some may use *Pot*, only Heaviside uses *Pan* also.

Lastly, we have his symbolic methods for solving the differential equations of physics. These deliver the goods, but the methods of their inventor were far from rigorous. In this they resembled the work of other pioneers, e.g., those who founded the ordinary calculus, or projective geometry. While it is trivially true that if a theorem has not been proved rigorously it has not been proved at all, yet a method which works, without being rigorous, should not be ignored by the mathematicians but welcomed as a challenge. The ensuing rigorous investigations always do more than merely underpin: they reveal the limitations of the method, and without them the time comes when the method yields errors.

For Heaviside's work the rigour was provided by Bromwich and Carson, as far as ordinary differential equations are concerned. Work still remains to be done on partial differential equations. Bromwich used contour integration; Carson used Laplace transforms. The former method has a nineteenth-century flavour; the latter fills a niche in the very general work of the last twenty years on transformations in general species.

When a book reaches a second edition, after its first has been several times reprinted, the contents are well known and it has evidently been approved by the public. The reviewer has only to add that he agrees with the public judgment, and to refer to the changes in the new edition. These consist of five additional chapters (100 pages) on impulsive functions (Dirac's δ-function), theorems on the Laplace transform, solutions for large and small t, chains of differential equations, and boundary-value problems for ordinary differential equations. Thus we have a book containing applications to a large number of branches of physics. The pure mathematics is reduced to the necessary minimum.

If there are engineers or physicists who have not read the first edition, they should now repair their omission with the second.

H. G. Forder.

Radiophysics

The Fundamental Research Problems of Telecommunications. D.S.I.R. (London: His Majesty's Stationery Office, 1948. 80 pp.) Price, 1*s*. 6*d*.

This publication summarizes the gaps and deficiencies in existing knowledge in the telecommunications field, as determined by a number of working parties appointed by the Telecommunications Research Committee (an *ad hoc* committee of the Department of Scientific and Industrial Research, constituted in March 1946). The working parties each consist of ten to fifteen representives from Government research laboratories, Service establishments, universities, and commercial firms. The subject is divided into nine sections, one working party covering each of the subjects: wave propagation, line propagation, valve fundamentals, properties of materials, contact phenomena, circuitry, luminescence, photo emission, and television appraisal. Summaries and full reports of each working party are given.

The reports vary in length, detail and types of research suggested. For example, that of the Properties of Materials party is a concise tabulation of important general research problems in every section of this field; research or development of many materials with specific magnetic and electrical properties is suggested. The report on Valve Fundamentals, on the other hand, is disappointing, and the specific suggestions, particularly in primary thermionic emission, relate only to technical improvements which lead to no further understanding of the basic physics involved, essential for further development of such cathodes. Two of the reports, Wave Propagation and Line Propagation, point out that just as important as the need for further research is the need for surveys of existing knowledge and wartime research results at present unpublished or published in widely scattered journals, sometimes of restricted circulation.

In Circuitry, main emphasis is on the importance of the analysis and design of networks in terms of transients, the more direct transient approach now being of major importance. One report, that on Contact Phenomena, points out that past investigations have been on mainly empirical lines and that what is now needed is a really basic investigation of the relevant physical and chemical behaviour of surfaces. In two cases it is considered that future planned research can only be effectively carried out by teams of scientists acting in close collaboration—electrical and chemical specialists in Materials; technical and psychological workers in Television Appraisal. One remarkable omission is any reference to research on the factors affecting overall telecommunication system design, an extremely important subject with the advent of many and varied modulation systems, the Vocoder

and similar devices, the reformulated Hartley Law, etc.

This publication should be valuable to workers on telecommunications as a survey of gaps in existing knowledge, covering the whole telecommunications field and presented by committees of research workers each of whom is a leading specialist in his own subject.

R. E. AITCHISON.

INDUSTRIAL ELECTRONICS REFERENCE BOOK. By Electronics Engineers of the Westinghouse Electric Corporation. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall Ltd., 1948. 680 pp., profusely illustrated with photographs and text-figs. 8½″ × 11½″.) Price, $7.50.

Advancement in the industrial aspects of electronics since 1940 has been widespread and rapid: new techniques and developments in old methods have been many and varied. This book sets out to cover the industrial applications of electronic methods and 'has been aimed at the practising engineer who is faced with the problem of understanding the underlying principles as well as the scope and limiting factors of electronic apparatus as it is applied to industrial processes'. It is written by a group of engineers of the Westinghouse Electric Corporation and co-ordinated by a second group of engineers of the same Corporation.

A fairly extensive knowledge of fundamentals is assumed. In the first three chapters a review of the physical background is given as a starting point for the development of the later parts of the book.

The kinetic theory of gases, atomic structure, the electronic theory of solids, the theories of field emission, thermionic and secondary emission, and photoelectric emission are dealt with thus.

Electron tubes, including X-ray and cathode ray tubes, are described in Chapters 4 to 10; circuit components, tuned circuits, filters and transformers are discussed in Chapters 11 to 14. The section on transformers covers the general design of communication transformers, including video and pulse transformers. Rectifier, amplifier and oscillator circuits, various control circuits, transmission lines and antennae are covered in succeeding sections up to Chapter 20.

The remainder of the book, to Chapter 33, gives various industrial applications and describes many types of equipment such as power rectifiers, inverters, radio-frequency heating devices and power-line carrier equipment. Electronic control of motors and resistance welders, industrial X-ray, electrostatic precipitation and electronic instruments are also discussed. A short chapter on radar fundamentals and two chapters on maintenance conclude the book.

The very large field which has been covered must necessarily constitute only an outline of the various subjects. Nevertheless the authors have set out to produce a handbook and in this respect have succeeded. A difficulty in writing a book in which a number of subjects are presented by different authors, is to co-ordinate the whole. There is good continuity throughout and the duplication of subject matter has been kept small by careful editing.

This volume will be found useful as a guide to the uses and practical possibilities of electronic equipment by graduates who are entering the field of electronics and find themselves faced with the problem of selecting one of the various methods possible in any engineering project. It is liberally illustrated and there are good lists of references appended to nearly every chapter.

R. F. MURPHY.

Spectroscopy

THE SPECTROGRAPHIC ANALYSIS OF SOILS, PLANTS AND RELATED MATERIALS. By R. L. Mitchell. (Technical Publication No. 44, Commonwealth Bureau of Soil Science, 1948. 183 pp.) Obtainable from C.A.B. Liaison Officer, 314 Albert Street, East Melbourne, C.2. Price, 15*s.* 8*d.*

Spectrochemists who are interested in the analysis of non-conducting, refractory solid samples have been somewhat handicapped by the lack of a book dealing specifically and in detail with their interests. This technical communication does not claim to be a textbook, but 'an attempt to review the literature on spectrographic methods of analysis that are relevant to the investigation of soils, plants and related substances and to present some details of the methods of analysis which have been worked out in the Spectrographic Department of the Macaulay Institute'. Within the scope of these aims, Dr. Mitchell presents a very readable account of the subject.

An outline of the fundamental principles of spectrochemical analysis is followed by detailed information on individual items of equipment. It is difficult to decide how much fundamental spectroscopic theory should be included in such a book: the greater part of Dr. Mitchell's 'superficial discussion' could perhaps have been omitted. The third chapter deals with the photographic plate, the microphotometer, the stepped sector wedge and methods of photometry, including a good discussion of background correction. Some loose phraseology is to be deplored: the implication of the Lambert-Beer Law is incorrect as it stands on page 26 and the expression on page 29, 'the ratio of the log relative intensities' should read 'the log of the ratio of intensities'. The section on the photographic plate is disappointing: no mention is made, for example, of the errors which are associated, some unavoidably, with the use of a plate.

Methods of analysis based on the flame as a source of excitation are thoroughly treated; both the Lundegardh and Ramage methods are included. Three chapters are devoted to methods using the electric arc as a source of excitation. Full details are given of the equipment and methods of the Macaulay Institute and sufficient information about other methods. Analytical methods using spark excitation are generally unsuitable for refractory solids and are discussed shortly. A short chapter is given to an account of the direct measurement of intensity of radiation by more or less complicated photoelectric meters. Although this method of photometry has not yet been used to any extent in agricultural work, it can be expected to play an important part in the future.

In the chapter on the determination of individual elements, the elements chosen are well selected to bring out points which will be helpful to the novice. The collection and preparation of samples is treated in detail and the section on methods of concentration is welcome because such methods will become more and more important as the agricultural chemist searches for elements at lower and lower concentrations. There is a useful section on the purification of chemicals and standards, which could have been extended to advantage. The final chapter is on the application of spectrographic methods of analysis to agricultural samples and gives a concise summary of all work that has been done and of the results obtained.

The only serious weakness of the book is the lack of any connected discussion on the accuracy of the spectrochemical methods, on the measurement of that accuracy and on the important sampling errors. Figures for accuracy given in spectrochemical literature are quoted. As the majority of these figures are meaningless and no attempt at critical evaluation is made, one would be wise to treat all of the figures with considerable reserve unless the literature is well known.

A good bibliography of about 750 entries is included, practically all of which are of spectrochemical interest. Of the three appendices, the atlas of an arc spectrogram will be generally useful; the two tables are for particular application only. The book should be read by every agricultural chemist who wishes to keep abreast of modern methods of analysis. It should find a wide circle of readers among those engaged in soil science and the related biological sciences. It could be read with profit and used as a handbook by all whose duties include the spectrochemical analysis of refractory soil samples. With some elementary spectrochemical knowledge and the help of Dr. Mitchell's book, an aspiring agricultural spectrochemist should soon be on the highway to success.

A. C. OERTEL.

SPECTROSCOPY AND COMBUSTION THEORY, 2nd ed. rev. By A. G. Gaydon. (London: Chapman and Hall, 1948. 242 pp., 4 plates, 13 text-figs., 7 tables. 5½" × 8½".) English price, 25*s*. net.

In the second edition of this well-known book the author has added some new material and has brought thermochemical constants up to date, including the ever dubious heat of vaporization of carbon. The very brief introduction to molecular spectroscopy at the beginning of the book has not been expanded, but an extensive knowledge of this subject is evidently not required for an understanding of combustion processes.

The chapter on hydrogen flames has been enlarged, and a paragraph on the H_2–N_2O flame added. A mechanism for the formation of CH radicals from C_2 is discussed on page 46. A new theory to account for the formation of solid carbon in the flames of hydrocarbons is announced (pages 57-58). An additional chapter on continuous spectra and the role of atomic oxygen in combustion has also been introduced.

Two new plates have been added to the second edition. Of particular interest are those of the spectra of the combustion of NO with H_2 and CO. The book will continue to be a source of important information for those who are interested in flames and luminescence.

T. IREDALE.

Zoology

FIELD GUIDE OF BIRDS OF THE WEST INDIES. By James Bond. (London: Macmillan; New York: The Macmillan Company, 1947. 257 pp., map, coloured plate and 211 line drawings. 5" × 7½".) English price, 19*s*. net; American price, $3.75.

Dr. Bond, who is Associate Curator of Ornithology at the Academy of Sciences, Philadelphia, is a noted authority on birds, and is to be congratulated on the production of this useful and much needed book. The magnitude of condensing scientific writings and reproducing the information in popular form can only be fully appreciated by those who have attempted this type of work.

This excellent little book would have been considerably improved by the inclusion of a key to the species, or even genera, however simply prepared; but the omission is largely offset by the excellent line-drawings and the careful descriptions of essential colours, measurements and other features associated with field or workroom identifications.

Though written in popular style and prepared for the field observer in particular, the book would be indispensable to any professional or lay ornithologist visiting the West Indies. It would be a very useful addition to any ornithological library.

J. R. KINGHORN.

·SUPPLEMENT TO

The Australian Journal of Science

VOL. XI 21 February, 1949 No. 4

TETRAKTYS

The System of the Categories of Natural Science and its Application to the Geological Sciences

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SUMMARY

A system of categories is described, being of a wide range of applicability to the natural sciences, particularly to the geological sciences. The categories are the *Ultimate Irreducible Modes of Being of Natural Units* (*Entities of Nature*) *as perceived through the Senses*. They are divided first into two orders, represented by the twenty-four *Categories of Substantial Being* and the four *General Categories of Existential Being with respect to Space and Time*.

The categories are combined with the *Four General Physical Conditions of the Atmosphere as perceived through the Senses*, namely the Caloric, Humidity, Light and Pressure of the atmosphere, called the C-H-L-P-World. These physical conditions are not categories as such—because they do not refer to 'natural units exhibiting boundaries perceivable through the senses'—but they are categorical concepts—because the sense operations through which they are recognized are of an ultimate and irreducible nature.

The highest principles of division and grouping of the new system of categories are the forms of apprehension, space and time. The system is called the TETRAKTYS, because of the fourfold, partially tetrahedral, spatial arrangement of its parts and elements.

The TETRAKTYS was developed from, and is applicable (without restriction and modification of its original form) to any natural units corresponding to a complex of certain conditions of a very elementary nature, called the *Natural Conditions*.

The working conditions of ordinary geological field investigations correspond in nearly all points to the natural conditions of validity of the TETRAKTYS. Furthermore, the majority of the ordinary methods of investigation used in the geological laboratory are so closely connected with, and controlled by, the use of the ordinary senses, that they are called the *Near-Natural Working Conditions* (examples are rock and mineral determination by means of the external characters; the blowpipe; simple chemical tests; even the polarizing microscope). This makes possible the use of the TETRAKTYS in the most diverse parts of geological and mineralogical investigations.

Only outlines are given of the method by which the TETRAKTYS was first deduced, namely from a comparative study of the meaning of the common names for natural things, and their use as homonyms and synonyms respectively.

The system of categories shows close coincidence with the elements and the working conditions of R. Jameson (1816): *Tabular View of the External Characters of Minerals*, and it exhibits the closest relationships with Aristotle's System of Categories in as much as it is applied to Natural Science.

The TETRAKTYS fully embraces, and completes, the *Schedule for the Field Description of Sedimentary Rocks* compiled by American sedimentary petrologists (Goldman, 1922). The scheme of the TETRAKTYS can immediately be used for building up schedules for the field investigation of any geological units (lithological, mineralogical, palaeontological, etc.). A *Schedule for the Field Investigation of a Volcanic Neck or Neck Formation*, built up on the scheme, is represented in full detail. The natural relationships (temporal, spatial, genetical, etc.) of these natural units can immediately be expressed in the categorical terms of the TETRAKTYS. The very numerous combinations possible between the parts and elements of the TETRAKTYS can immediately be subjected to mathematical calculations.

Extensive studies into the literature on mineral determination prove that the TETRAKTYS can be made a basis for the whole process of mineral determination.

In conclusion a *Thought-Scheme* is given, called *Investigation of a Natural Unit*. The scheme illustrates the interconnexion of the four constituent parts of any complete investigation into a natural unit; namely, Observation (through Sense-perception), Determination (through Discrimination), Classification (through Grouping), and Description (after Naming) of the natural unit. The thought-scheme represents the general key to all main types of application of the TETRAKTYS.

INTRODUCTION

The Tetraktys, or System of the Categories of Natural Science, described in this paper was first presented in an address delivered to the Geological Section of the Royal Society of New South Wales on 23 July 1948. A short summary of the address has been published in This JOURNAL (Koch, 1948).

This first presentation of the new system of categories was carried out in the form of a detailed comparison of all of its parts and elements (as well as their interconnexion) with all parts and elements of the *Schedule for the Field Description of Sedimentary Rocks* (Goldman, 1922; Twenhofel, 1926). It was shown that there was no element, not even the most specialized detail in the schedule, for which a corresponding place (or number of places) could not be found in the Tetraktys. On the other hand, only half of the categories or categorical concepts of the latter proved to be covered by corresponding elements of the *Schedule*.

This result of the comparison—which will be published in full detail later—appears to be the more remarkable as the new system of categories was never intended to be limited to the purposes of sedimentary petrography or to the geological sciences only. On the contrary, as will be shown in the following pages, this system of categories, according to the general method of its deduction, and as indicated by its name, is not restricted to any particular part of Natural Science ; inasmuch as the objects of the sciences to which it may be applied correspond to certain elementary conditions.

Nevertheless, for certain reasons explained in this Paper, the Tetraktys proved to be particularly applicable to the investigation and representation of the objects of the geological sciences. In view of the highly general character of the system, and in order to avoid unnecessary repetition of the data which are common to all of its applications, it appears desirable to introduce the new system first in a more general picture, and as a self-contained unit. Furthermore, since the other fundamental schemes with which it will be compared, and the objects to which it will be applied, are all of an empirical character, it seems sufficient to introduce the Tetraktys first as an empirical structure, and to keep theoretical discussions to a minimum.

Questions as to why the Tetraktys should have this particular form and no other—this particular number of elements and no more—cannot be solved by the theories of any particular branch of Natural Science alone. The full discussion and scientific proof for these questions have to be founded on a broader basis, extending over wide fields of the most diverse sciences and philosophy.

The Tetraktys: Its Deduction, Relationships and Applications

Part I. 1. General Definitions and Explanations

(*a*) *Presentation and Study of the Tetraktys*

The Tetraktys, or System of the Categories of Natural Science, is shown in Table 1. This table illustrates the different categories and categorical concepts as well as all other parts and elements of the system, in their spatial arrangement and interconnexion.

The text used in the Table represents the shortest possible form of expression of these concepts in words, used either as names or in incomplete phrases. In order to assure the highest degree of clarity of the Table, the number of words used for its text had to be kept as small as possible, totalling about one hundred and sixty. These words, therefore, have to be considered rather as signals, or word-symbols, of the concepts designated by them. In certain instances, they cannot be considered as rendering the complete meaning of these concepts, in view of their highly abstract and condensed nature.

It is therefore recommended, particularly in the beginning of study of the Tetraktys, that this Table be always used in connexion with the full text of the definitions as given on pages 3–16, which embraces all the categories and categorical concepts represented in the scheme. The Table should also be used constantly in connexion with the *Schedule for the Field Investigation of a Volcanic Neck or Neck Formation*, pages 24–25, which illustrates all categories, etc., of the Tetraktys by the different phenomena exhibited by an eruptive body as a natural unit or entity of Nature.

(*b*) *The Name 'Tetraktys'*

The name *Tetraktys* was chosen for the following reasons. When written as 'Tetraktis'—i.e., with 'i'—the word can be considered as composed of two Greek elements, namely : τέτρα (*tetra*—'four') and ἀκτίς (*aktis*—'ray'). The meaning of the name then is : *The four-rayed.* It refers to the most characteristic feature of the Tetraktys, namely the four rays radiating at equal angles from its centre, to the corners of a tetrahedron—which corners represent the centres of four *Spheres of Categories.*

When written as 'Tetraktys'—i.e., with 'y'—the meaning of the word can be rendered as *entity consisting of four things* (Delatte, 1915, p. 249 ff.). In this form the name refers to the fact that the whole Tetraktys, as well as many concepts of the philosophical system of which it is only one constituent part, are characterized by groups of four elements. Such groups of four elements or concepts are called *Tetrads.*

The name *Tetraktys* occurs in the earliest period of Old Greek Philosophy, where it designates one of the most fundamental concepts of the Pythagorean doctrine. Although the deeper roots of this doctrine have been kept in the utmost secrecy, the important role attributed to the number FOUR, as well as the fourfold structure of certain fundamental concepts of the Pythagorean philosophy, is apparent.

(*c*) *Definition of a Natural Unit*

A *Natural Unit,* in the sense of the System of the Categories of Natural Science, is any part or

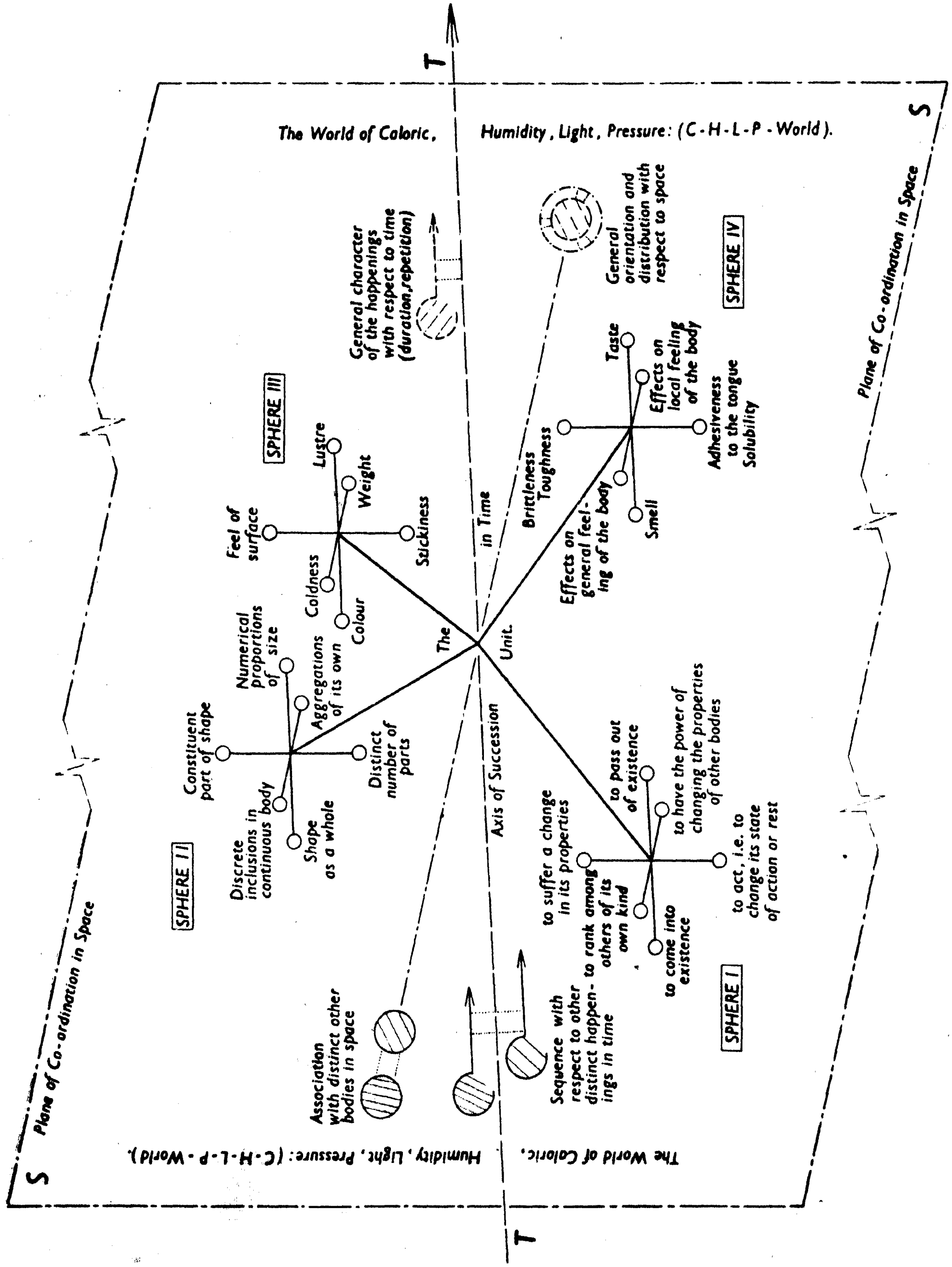


Table 1

TETRAKTYS. THE SYSTEM OF THE CATEGORIES OF NATURAL SCIENCE

phenomenon of the natural material world which exhibits boundaries perceivable through the senses. The definition of a natural unit is not restricted to units of substance alone, but it also embraces units of natural happenings marked by discontinuities or changes in the general character of these happenings. A cycle of rhythmic sedimentation, or of rhythmic precipitation or crystallization, or even a tune from a bird's song, is such a natural unit of happenings. The symbol designating any natural unit of substance or happening is U. Any other natural unit different from U is symbolized U', U'', etc.; or U_m, U_n, U_o, etc.

Some of the parts or happenings of the material world of Nature exhibit more distinct or better developed boundaries than others. An idiomorphic crystal of the mineral gypsum embedded in a mass of clay, or a bird in the air, represents a better defined unit than, for example, a certain fibre out of a compact mass of fibrous serpentine, or one out of the innumerable organisms which live together in a colony of sponges. Certain natural units, therefore, can be said to be more distinct units than certain others. It depends on the choice made by the perceiving person, as to which one out of the unlimited number of possible natural units should be *the* unit of one act of observation or chain of observations. The observing person decides which is to be the unit, in a certain moment or period of time, of which the combined multiplicity of properties or phenomena shall be observed through all senses possible, or through those senses which are intentionally directed upon it. A natural unit, therefore, is always defined with respect to the person, ME, who perceives it.

Furthermore, it depends upon selection or choice, in other words, upon an act of will, which boundaries perceivable shall be taken in a certain act or chain of observations, to be the boundaries of the unit to which these observations shall be confined or on which they shall be centred. This choice, then, is independent of the fact, from which units U', U'', etc. (of higher order) the unit U in question is separated by the boundaries chosen; and independent also of the existence of units (of lower order) into which the unit U appears divisible by inner boundaries included in the boundaries first chosen.

The scheme of the Tetraktys shows the spatial arrangement of all categories or ultimate modes of being of a chosen natural unit, irrespective of the existence of other units (of either higher or lower order) with which the first chosen unit coexists in the world of Nature. At the same time, the Tetraktys contains all categories by means of which any mode of connexion of one given unit, U, with another unit, U', can be expressed in categorical terms and symbols. Connexion of a given unit U can exist either with another unit U' associated with it, or with a unit U'' of higher order than itself and therefore embracing it, or with any unit U''' of lower order than itself and therefore embraced by the first unit U.

In the practical case of a geological field investigation, a geological unit may present itself as a quite distinct unit; for example a conical hill of basalt arising from a plateau built up of sediments, or the well preserved calcareous shell of a brachiopod embedded in marl. In other cases the geologist may be forced to select, as a unit of a sedimentary rock, a small layer of sandy shale exhibiting only transitional 'boundaries' with more clayey beds. In certain cases, particularly of sedimentary petrography, the selection of the unit to be designated and dealt with as a unit of investigation is a fairly deliberate one.

The first step to be taken in making a detailed geological or petrographical field investigation is to choose the *right* unit or entity of Nature. This may sometimes be a rather difficult task; for example, in the case of certain types of paramagmatic ore deposits imperfectly exposed by denudation. Success, or rapid progress of the investigation, depends to a considerable degree on the initial choice of the unit.

Nevertheless, if it becomes apparent in a more advanced stage of the investigation that the first choice or selection of the unit was not the best possible, there will always be the opportunity of changing over to another unit proving to be more distinct and more easy to describe than the first chosen.

The second step, no less important for the successful progress of such an investigation, is to find out that particular category, or those categories or modes of being, which correspond as closely as possible with the relationship between the main unit investigated and the other natural units associated with it or included in it. The importance of this point is illustrated in Part IV, 2 (*a*), in connexion with the construction and use of schedules for geological field investigations.

(*d*) *The Natural Conditions of Validity of the Tetraktys*

The *Natural Conditions* are a complex of conditions of elementary character with respect

to which the Categories of Natural Science are defined. They constitute, in their entirety, a system of concepts somewhat analogous to the system of categories.

This system of the Natural Conditions is not the product of deliberate selection, but was found (and recognized as a well defined complex) together with the empirical deduction of the categories as described in Part II, pages 16–18. This complex therefore represents the whole of the conditions under which the Tetraktys or System of the Categories of Natural Science is *valid*. For example, the Tetraktys can immediately be applied, without any further restrictions or modifications, to the representation or investigation of the phenomena of any units (of substance or of happening) which correspond to these natural conditions.

Of the complex of natural conditions, only that part is quoted below which is indispensable for the discussion of the problems dealt with in this Paper, as well as for the understanding of the examples illustrating them. Inasmuch as these Natural Conditions refer to the *material world*, they are defined as follows:

(i) The natural unit, or entity of Nature, of natural origin, in its natural surroundings and connexion, not influenced or modified by artificial or technical means or procedures of man.

(ii) The observing person, ME, in the state of full consciousness and health, and in full possession of normal senses and sense-organs.

(iii) The sense-contact by which the natural unit comes into existence in my consciousness, established in the natural way, not produced by artificial means or methods, or intensified in degree by use of artificial means.

Inasmuch as the immediate results of the sensations felt by the perceiving person may be put into words (which is by no means necessary in all cases of observation), the Natural Conditions are extended in such a way as to cover also the existence of the natural unit as a *concept of mind*:

(iv) The judgments made concerning the sense perceptions, and expressed in words (spoken or written), shall be direct ones, representing only statements about the content of the sensations themselves. Results obtained from chains of syllogisms, or from the application of mathematical calculations to the sense data, are not included in the Natural Conditions, even when these syllogisms and calculations refer ultimately to sensations received in accordance with the Natural Conditions as given above.

Any sense-perceptions received through use of artificial means, or under artificial circumstances, or referring to units which are not natural, are to be considered as made under artificial conditions.

In view of the rigorous and exclusive character of these Natural Conditions, the question has to be discussed as to what degree of correspondence there is between these conditions and the objects of the geological sciences or the ordinary methods of geological and mineralogical investigation. Obviously the extent to which the Tetraktys will be applicable to the geological sciences depends on the similarity of these conditions (see pages 20–22).

(e) *Categories of Natural Science and their General Characters*

(i) *The Categories as Such.* A category in the sense of the System of the Categories of Natural Science is the concept of an ultimate irreducible mode of being of a distinct natural unit recognized by sense-experience carried out under certain definite conditions called the *Natural Conditions.*

The categories contained in the Tetraktys are divided into two orders of categories—the ordinary categories and the general categories. To the former order belong the *Substantial Categories*, as being of an ultimate and irreducible character, and therefore categories in the proper sense of the definition given above. To the latter order belong the *General Categories of Existential Being* as discussed and defined in Part I, 2 (*d*).

Within the precincts of the Categories of Substantial Being (or Substantial Categories), further distinctions based on direct sense-perception can be made either with respect to degree or intensity, or to kind, of these modes of being. The concepts of 'heavy' and 'light' are such distinctions with respect to *degree*, made within the precincts of the category *Weight, cat. $III-b$.* 'Yellow' and 'red', 'sweet' and 'bitter', are examples of such distinctions with respect to *kind*, made within the precincts of the categories *Colour, cat. $III+a$*, and *Taste, cat. $IV-a$*, respectively.

One of the general essential characters of a category is that it cannot be deduced logically from another category of the same system. It even seems that a category cannot be derived at all by any direct logical procedure, but only indirectly from very great masses of synthetic judgments, as illustrated by the deduction of the Categories of Natural Science (see Part II). Another essential

character is that the categories belonging to the same system cannot overlap one another. In other words, the precincts of these concepts must be perfectly separated from one another. Conversely, it is not possible to prove by simple logical argumentation that a certain concept is a category belonging to a certain system. This is merely to be proved empirically by as many *illustrations* of that category as possible; in other words, by the application of the category in question to as many different empirical facts of the reality of Nature as possible.

The proof for the categorical character of the Categories of Natural Science, therefore, is a proof of probability, gaining in strength by every empirical fact of the world of Nature to which it can be applied in accordance with the definitions and conditions given in this Paper. This proof of probability will be particularly strengthened once the application of the Tetraktys is extended to parts of Natural Science far beyond the precincts of the geological sciences; for example, to the empirical facts of botany, zoology, meteorology, etc.; and, not least, to the knowledge and representation of the states of health of the human body as recognized by medical diagnosis, which is based mainly and ultimately on sense-perception.

(ii) *The Categories in Combination.* Two or more categories belonging to the same system can have certain characters *proportionally common.* They then form groups, or sub-groups, or *Spheres* of categories each characterized by certain characters specific to the categories of that group. A certain group of categories is distinguished from another, or from all others, by such group-characters. Some of the characters distinguishing the four Spheres, *I* to *IV*, of the substantial categories are given below together with the definitions of the different categories building up these Spheres (see pages 10–11).

Once a sufficient number of specific characters of groups or sub-groups have been found out empirically, these group-characters can be used in turn for improving the formulation (i.e., the precise expression in words) of the categories embraced by that group. Extensive use of this principle was made during the process of the deduction and improvement of the Tetraktys. Details of the process cannot be given in this Paper, because it required several ten-thousand individual acts of thinking during the empirical deduction of the system.

With regard to the Tetraktys as a complete system or totality of categories, the following essential characters of this system have to be mentioned here; namely, the *Homogeneity* and the *Invariability* of this system. First, the Tetraktys or System of the Categories of Natural Science is *homogeneous* with regard to the fundamental principles with respect to which all of its parts and elements are defined and connected uniformly. Secondly, the form or pattern of the Tetraktys is *invariable* with respect to its applications to the most diverse facts of the reality of Nature. Whatever is expressed in terms of the Categories of Natural Science does not require any modification of the original (geometrical) form of the Tetraktys as represented in Table 1.

(*f*) *The Tetraktys as a Spatial Configuration and Thought-Scheme*

The Tetraktys is called a System, not a Table, of Categories. The latter word, which involves the idea of arrangement in a plane and which is ordinarily used in philosophical terminology for Aristotle's system of categories, should be avoided. The spatial configuration of the Tetraktys is to be considered as its most essential feature, distinguishing it from other schemes which have been developed for similar or more specialized purposes.

The adequate representation of the Tetraktys, therefore, is a three-dimensional model. Such a model, representing the configuration of the twenty-four substantial categories, was shown on the occasion of the address mentioned above (Koch, 1948). For all ordinary purposes, the Tetraktys is shown or used in the form of its projection on to a plane. The method used for its projection in Table 1 and Fig. 1 is the clinographic projection (Tutton, 1922) which is in general use for crystal drawings or the illustrations of crystallographical publications. For other purposes, other methods of projection may be chosen; for example, in the construction of *forms* showing the pattern of the Tetraktys as a whole, or of its different parts. These forms are used in connexion with *schedules* for geological and other investigations in the field as well as in the laboratory (see pages 24–25, 29).

The leading principle in choosing the method of projection and grouping of the different parts of the Tetraktys should always be that the 'forms' used for its practical applications may help to explain the spatial interrelationships of the facts and concepts plotted on them and to illustrate in a visible scheme their innumerable possibilities of combination with one another. Finally it may be mentioned that the Tetraktys, as it is presented in Table 1, is to be considered as a *Thought-Scheme*

showing in visible arrangements the spatial interconnexion of certain distinct concepts of the mind, such as the categories, categorical concepts, etc. (see pages 29–30). Groups of four elements, called *Tetrads*, play an important role in the Tetraktys as well as in other thought-schemes.

Part I. 2. The Tetraktys, its Parts and Elements

(a) Division and Parts of the Tetraktys

As shown in Table 1 and illustrated by the schematic Fig. 1, the whole System of the Categories of Natural Science is divided, first of all, into four main constituent parts; partially surrounding, partially penetrating, one another.

(i) The central part of the system is occupied by a group of twenty-four categories distributed on four sub-groups of six each. These sub-groups are called *Spheres of Categories* and are numbered *I* to *IV*. The totality of these twenty-four categories is called the *Substantial Categories*, or *Categories of Substantial Being*. Their spatial configuration is called the *Tetraktys* proper, because of the tetrahedral arrangement of the four Spheres around the centre of the system.

(ii) This central group of the substantial categories is surrounded by another group, of what are called the *Four General Existential Categories*, or the *General Categories of Existential Being*. Their geometrical arrangement, as well as their symbols (geometrical and letter-symbols), is shown in Fig. 1.

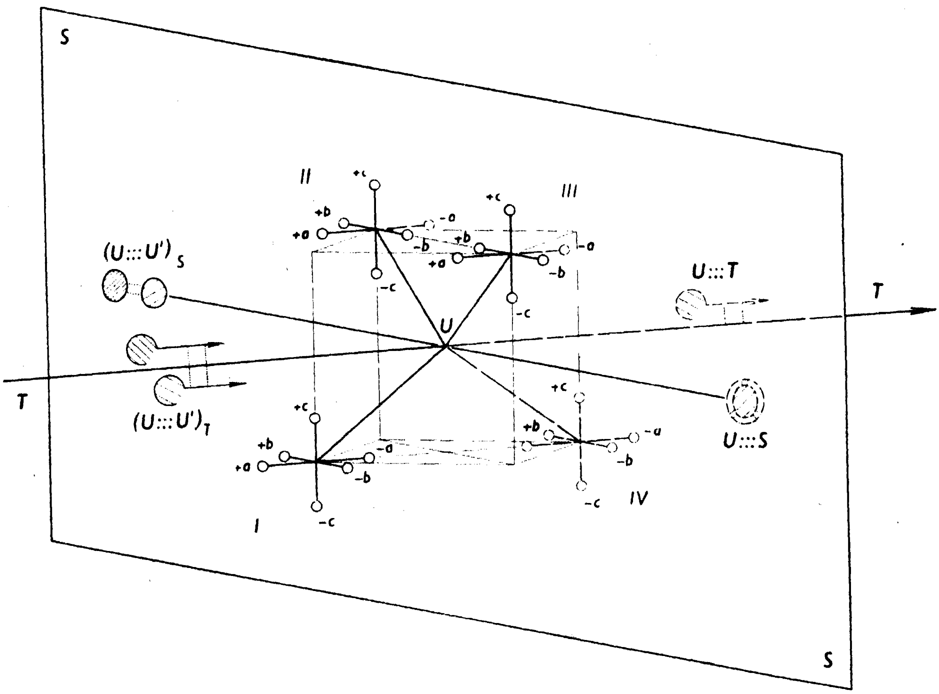


Figure 1
GEOMETRICAL CONFIGURATION AND SYMBOLS OF THE TETRAKTYS

(iii) The combined complex of the substantial and existential categories is surrounded by what is called the *World of Caloric, Humidity, Light and Pressure*, abbreviated the *C-H-L-P-World*. Its synonymical name is: *The Four General Physical Conditions of the Atmosphere as perceived through the Senses*. These four general physical conditions have no definite geometrical 'place' or 'locus' in the configuration, except that they surround (and penetrate) in their totality the complex of all other categories. In Table 1 this fact is symbolized by indicating,

both on the left and right sides of the complex of the categories, the *names* or symbols of the C-H-L-P-World.

(iv) The system as a whole is penetrated both by a plane, S, and by an axis, T, which are perpendicular through one another, and which both go through the centre, U, of the system. This plane is called the *Plane of Co-ordination in Space*; the axis is called the *Axis of Succession in Time*.

The spatial configuration representing the *whole* of the System of Categories of Natural Science in its entirety is called *Pan-Tetraktys*, from the Greek πᾶν (*pan*—'all', 'entire'). This name is used in case, for special reasons or purposes, the system of the categories as a whole is to be distinguished from its central part which was called the *Tetraktys proper* (see above). In ordinary use, the abbreviated name *Tetraktys* may be sufficient to designate the whole system as shown in this Paper.

(v) The centre or central point of the whole configuration of the four main parts of the Tetraktys is the *locus* of what is called the *Natural Unit*, briefly designated as *The Unit* and symbolized by the letter U. It can also be called the *Undifferentiated Natural Unit*. Of this undifferentiated unit all categories or modes of being represented in the scheme are the *Differentiations*, shown in their dependence upon the General Physical Conditions and in their division and grouping according to the forms of apprehension, space and time. On the other hand, considering this natural unit in the sum of all its categories of being as described above, this entirety of concepts can be called the *Integrated Natural Unit*, or the *Integrated Entity of Nature*.

(*b*) *Geometrical Configuration of the Tetraktys, its Parts and Symbols*

The geometrical configuration of the Tetraktys is illustrated by Fig. 1, which shows the scheme of the Tetraktys in its relationship with a cube. The centre, U, of the Tetraktys coincides with the centre of the cube. The four Spheres of Substantial Categories, Nos. I to IV, of the Tetraktys are represented in its ordinary scheme by a system of three axes, a, b and c, intersecting each other at right angles. The points of intersection of these axes, corresponding to the centres of the four Spheres mentioned, coincide with four alternate corners of the cube; thus illustrating the tetrahedral configuration of these four Spheres around the centre U of the cube and the Tetraktys as well.

All c axes lie in the 'vertical' edges of the cube, or their prolongations; all a and b axes coincide either with one or the other of the diagonals of the (upper or lower) basal planes of the cube, or with the prolongations of these diagonals, or they are parallel to these diagonals. All respective plus-branches and minus-branches of the a, b and c axes of the four Spheres, I to IV, have corresponding positions; the positive branches lying on the left and upper sides of the Spheres, the negative branches on the right and lower sides of the Spheres.

The plane S goes through the corners II and III of the cube and through its centre U, thus cutting the cube diagonally. The plane S shown in the figure is only a finite, limited part of the infinite Plane of Co-ordination in Space, S, of the Tetraktys. In the ordinary representation of the Tetraktys as shown in Table 1, the upper and lower boundary lines of the finite plane S are broken for economy of printing space. All b and c axes of the four Spheres, I to IV, lie either in this plane S or in planes parallel to it.

The axis T shown in the figure is only a finite, limited part of the infinite Axis of Succession in Time, T, of the Tetraktys. The axis T going through the centre U is perpendicular to S, and therefore to all b and c axes, but parallel to all a axes.

The geometrical symbols of the General Existential Categories designated by the letter symbols $(U{:::}U')_S$ and $U{:::}S$ lie in the plane S. The line which connects them by going through the centre U is an auxiliary line illustrating the position of these symbols. The geometrical symbols of the General Existential Categories designated by the letter symbols $(U{:::}U')_T$ and $U{:::}T$ are placed alongside the axis T, on either side of the centre U.

(*c*) *The Categories of Substantial Being*

The definitions of the twenty-four substantial categories, or *Categories of Substantial Being of Natural Units as perceived through the Senses*, are given in Table 2. They are plotted in accordance with their distribution on the four Spheres of substantial categories, Nos. I to IV. Within each of these Spheres, the definitions of these categories, accompanied by their symbols, are distributed on the respective plus- and minus-branches of the three axes a, b and c. The symbols of the different categories are to be read as follows: *cat.* $I+b$, 'category one, plus b'; *cat.* $IV-c$, 'category four, minus c'; and so forth.

Each of the four Spheres is characterized by a group-character (see pp. 10–11) called the *General*

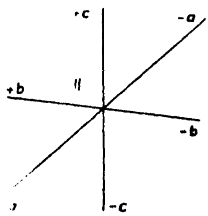
SPHERE II: **General** character—*The unit is perceived by features of quantity, either continuous or discrete.*

The unit is recognized immediately through sense-perception . . .

. . . to have distinct, but not self-existent, constituent parts of its shape as a whole; or to be a distinct, not self-existent, constituent part of a shape as a whole: *cat. II +c*

. . . to have distinct numerical proportions of its extent in different directions of its shape: *cat. II—a*

. . to occlude, as a continuous body, one or more discrete other bodies, or holes; or to be a discrete body or hole occluded by a continuous body: *cat. II +b*



. . . to build up aggregations together with similar units of its own kind; or to be divisible into similar units of its own kind: *cat. II—b*

. . . to have a distinct shape or form, as a continuous body in space: *cat. II +a*

. . . to have a distinct number of parts, or to be one of a distinct number of parts of a higher unit of shape: *cat. II—c*

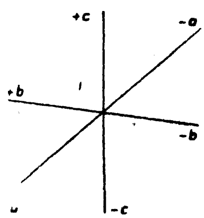
SPHERE I: **General** character—*The unit is perceived to appear or to act as an entity.*

The unit is recognized immediately through sense-perception . . .

. . . to suffer a change in its properties, by being acted upon, either mechanically by another body, or by a sudden change in the C-H-L-P-conditions: *cat. I +c*

. . . to disappear suddenly from the senses, with its combined multiplicity of properties: *cat. I—a*

. . . to be distinguished among a majority of other units of its own kind, by more extreme degrees of its properties: *cat. I +b*



. . . to have the power of changing or modifying certain properties of other bodies with which it is associated for a finite time: *cat. I—b*

. . . to appear suddenly to the with a combined multiplicity of its properties as a new unit, not existent before at the place of its appearance: *cat. I +a*

. . . to act (i.e. to change its state of action or rest); either from causes not perceivable through the senses, or by reacting instantaneously to a preceding action (this action may be forced upon it by another body, or by a sudden change in the C-H-L-P-conditions): *cat. I—c*

Table 2. DEFINITION OF THE

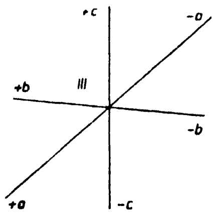
SPHERE III: General character—*The modes of being perceived are not necessarily dependent on a certain definite shape of the unit, but on a finite quantity of the unit, in order to be perceivable.*

The unit is recognized immediately through sense-perception . . .

. . . to have a smooth or rough surface to the gliding touch: *cat. III +c*

. . . to have a certain lustre (being shiny or dull): *cat. III—a*

. . . to feel cold or warm to the 'lasting' touch (in spite of having acquired the temperature of the surrounding air), the touch lasting for a short but finite time: *cat. III +b*



. . . to feel heavy or light when tested by the 'weighing' touch, estimated by lifting or tossing the unit against the force of gravity: *cat. III—b*

. . . to have a certain homogeneous colour to the sight: *cat. III +a*

. . . to stick to or adhere to the touching organ when this is withdrawn from the point of contact: *cat. III—c*

SPHERE IV: General character—*The process of perceiving these modes of being is accompanied by the destruction, or passing out of a perceivable state, of the unit perceived.*

The unit is recognized immediately through sense perception . . .

. . . to be ground, or deformed, between the teeth, as an expression of its elasticity, and as checked by 'tooth-hearing': *cat. IV +c*

. . . to have a certain taste (or none at all) to the touching tongue: *cat. IV—a*

. . . to produce a certain general feeling of the body as a whole, after being incorporated in it: *cat. IV +b*

. . . to produce a certain local pain or anaesthesia (numbness) after being introduced into the perceiving body: *cat. IV—b*

. . . to have a certain smell (or none at all) to the nose: *cat. IV +a*

. . . to feel 'dry' (adhesive) to the tongue, or to feel 'wet' (dissolving) on the tongue (the former is an expression of the forces of capillary attraction, and the latter is an expression of self-disintegration by going into solution): *cat. IV—c*

SUBSTANTIAL CATEGORIES

Character of that Sphere of categories. Another Tetrad of such group characters is as follows:

GENERAL CHARACTERS OF THE FOUR SPHERES OF SUBSTANTIAL CATEGORIES AS RECOGNIZED IMMEDIATELY THROUGH SENSE-PERCEPTION:

SPHERE *II*: The natural unit is recognized in its parts or by its parts and aggregations. (*Thing in itself, with its own.*)

Sphere *I*: The natural unit is recognized by its relations with other units. (*Thing with other things.*)

SPHERE *III*: The natural unit is recognized by its effects upon the outward senses of the perceiving body. (*Thing in contact with my outward senses.*)

SPHERE *IV*: The natural unit is recognized by its effects upon the inward senses of the perceiving body. (*Thing in contact with my inward senses.*)

This Tetrad of the general characters of the four Spheres of substantial categories is related with the thought-scheme given in Fig. 2, page 18. It can again be arranged in two sub-groups embracing the Spheres $I+II$ and $III+IV$ respectively. The categories embraced by the latter sub-group apparently coincide with the 'Affective Qualities' of the Old Greek Natural Philosophy, taken up again in modern philosophy since Locke. (See Whewell, Vol. 1, 1840.)

It is recommended that the text of the definitions of the substantial categories be read or studied in a certain order of sequence. The same is recommended for the study of the schedules built up on the scheme of the Tetraktys, for example of the *Schedule for the Field Investigation of a Volcanic Neck or Neck Formation* represented in Table 3, pages 24–25. With regard to the four Spheres *I* to *IV*, it is best to commence with Sphere *II*, to proceed to *III* and *IV* and finally to *I*. It is essential to start with Sphere *II*, because features of shape and number as represented by the categories of that Sphere are the most distinct modes of being of a natural unit, all representing modes of *Quantity*, either continuous or discrete (cf. page 20).

Within each of these four Spheres of categories, the following order of sequence is recommended for the study of the categories, in the original scheme of the Tetraktys as well as in the schedules built up on this scheme. The study of the categories starts in each Sphere with the respective category symbolized by $+a$ and proceeds in the following order:

$$cat.+a \rightarrow cat.-a \rightarrow cat.+c \rightarrow cat.-c \rightarrow cat.+b \rightarrow cat.-b$$

Certain analogies existing between corresponding categories in the four Spheres *I* to *IV* become apparent when the categories are studied in the order mentioned.

Nevertheless, the orders of sequence recommended in the foregoing paragraphs do not affect the fundamental character of the Tetraktys itself, namely the spatial arrangement and co-ordination of all of its parts and elements. This spatial co-ordination can by no means be adequately represented by any linear order of sequence of these elements. The orders of sequence recommended for the practical study of the Spheres of categories and their elements are therefore of a purely pedagogical or psychological nature, referring to the structure of human understanding, not to the structure of the Tetraktys itself.

(d) The General Categories of Existential Being

The *General Categories*, like the substantial categories defined above, are modes of being recognized through sense-experience. They also refer, like the substantial categories, to natural units as defined above; but the particular nature of each of these general categories does not depend on the kind of the sense, nor on the way that sense was used. They only represent the form in which a natural unit exists as *a* unit, with respect either to space and time or to another unit (or units) in space and time. Or, in other words, the general categories of existential being are the general modes of existence of natural units as units, undifferentiated with respect to the particular senses and their different sensations, but differentiated with respect to general sense-experience of the forms of space and time.

As indicated by the name, these four general categories are called 'general' because they are not ultimate with respect to sense-experience but can be split up into several existential categories which in turn are ultimate and irreducible. The four general categories of existential being therefore represent an analogy to the four groups or Spheres of substantial categories described above.

The question may arise as to why, in the present investigation, the process of splitting up these general categories is not carried out to the same degree as the splitting of the four Spheres of substantial categories into groups of six each. The answer is that, for the substantial categories, the great number of names analyzed (more than 25,000) provided sufficient material for a complete analysis into the ultimate elements, i.e., the twenty-four substantial categories. On the contrary, the

number of names available for the deduction of the four general categories of existential being of natural things was only between five hundred and a thousand. This material proved to be quite sufficient for the establishment, as well as the separation, of these general categories from one another. The number of examples studied, however, proved not to be sufficient for splitting up these general categories into a distinct number of ultimate categories.

This process of the deduction of the existential categories, as in the case of the substantial categories, was checked by empirical data taken from the existential being of minerals with respect to space and time, the examples being taken from the geological and mineralogical literature, particularly from literature on mineral and ore deposits. The complete solution of the problem may be expected only from a systematic search for data concerning the existential being of natural things of *all* kinds, an investigation which has to be carried out throughout the most diverse parts of Natural Science, both inorganic and organic as well.

With regard to the occurrence of the common names referring to the categories of existential being of natural things, it may be mentioned that names of that type exist in all languages studied, even in those of the so-called primitive peoples. In general, however, the peoples of this world apparently prefer to designate natural things by their substantial characters or categories of being, rather than by such abstract characters as the 'modes of existential being with respect to space and time'. This may explain the comparatively rare occurrence of the latter type of name for natural things.

The definitions of the four general categories of existential being, as given in this Paper, appear to be based on sufficient empirical data as to be considered as definite and not transitional elements of the Tetraktys. This result is confirmed not least by the fact that these general categories of existential being exhibit close relationships with the analogous categories of Aristotle's system (see page 19). In addition to the examples quoted by Trendelenburg (1846), further substantial evidence for these relationships could be found in different quotations of the Aristotelian works. These will be discussed in detail later together with other results of these studies mentioned below (pages 19–20).

The definitions of the four general categories of existential being will be given first in the most general form possible. These will be followed (in accordance with the empirical method of presentation mentioned in the Introduction) by the definitions of the same general categories as 'the four general categories of existential being of minerals with respect to space and time', expressed in the more special terms of mineralogical science. These latter definitions will be illustrated by a number of examples taken from mineralogy and the science of the mineral deposits. Additional examples of these categories, presented as 'General categories of existential being of volcanic necks', can be studied in the *Schedule for the Field Investigation of Volcanic Neck or Neck Formation*, reproduced on pages 24–25. The latter examples also illustrate a number of combinations of these categories with each other as well as their meaning in the reality of Nature, as pointed out on page 28.

Definitions of the Four General Categories of Existential Being of Natural Units with Respect to Space and Time

Note.—In order to distinguish by symbols the general categories of existential being from the substantial categories designated by the abbreviation '*cat.*', for example *cat.* $I+c$, the abbreviation '*catg.*' is used for the letter symbols of the general categories. This abbreviation '*catg.*', for example in *catg.*U:::S, at the same time represents a mnemotechnic symbol corresponding to the expression of these categories in Latin: CAT*egoria* G*eneralis*=*catg.*

The definitions of the *General Categories of Existential Being* are as follows:

The natural unit U is recognized immediately from sense-experience—

(i) to be associated in space with a distinct other unit U', or distinct other units U', U'', etc.;

Letter symbol: *catg.* $(U:::U')_S$. To be read: General category U to U', in S.

(ii) to happen in distinct relationship of succession in time with respect to a distinct other happening U', or to distinct other happenings U', U'', etc.;

Letter symbol: *catg.* $(U:::U')_T$. To be read: General category U to U', in T.

(iii) to have a distinct positional character with respect to space (orientation, distribution, etc.);

Letter symbol: *catg.* U:::S. To be read: General category U to S.

(iv) to happen in a distinct temporal form in time (duration, repetition, etc.).

Letter symbol: *catg.* $U{:::}T$. To be read: General category U to T.

THE FOUR GENERAL CATEGORIES OF EXISTENTIAL BEING OF MINERALS WITH RESPECT TO SPACE AND TIME

Illustrated by examples.

catg. $(U{:::}U')_S$

The association in space of a certain mineral (mineral species) with a distinct other mineral (mineral species), or a distinct mineral association, or distinct geological formation, as material bodies.

Examples: Paragenesis of the minerals; mineral deposits characterized as magmatic, sedimentary, marine, etc.

catg. $(U{:::}U')_T$

The coincidence in time, or the antecedence or succession in time, of a certain mineral (mineral species) with respect to a distinct other mineral (mineral species) or other mineral formation, or a geological formation, as material products of consecutive geological happenings or processes.

Examples: Succession of mineral deposition; so-called primary and secondary (deuteric) minerals; syngenetic deposition of minerals.

catg. $U{:::}S$

The general mode of occurrence (orientation, distribution, etc.) of a certain mineral (mineral species) with respect to space; i.e., the upper part of the earth's crust as the empirical geological space.

Examples: Vertical orientation of stalagmitic or stalactitic mineral aggregates; minerals belonging to different depths of the earth's crust (Kata-, Meso-, Epi-zones of mineral formation); massive or sparse character of mineral occurrence or deposits, also called the intensive or extensive occurrence of the mineral species; persistence, or non-persistence, of a certain mineral species with respect to a given geological unit with which it is connected genetically; regular or irregular lateral occurrence or distribution of the different mineral species with respect to the surface of the globe.

catg. $U{:::}T$

The general mode of occurrence (duration, repetition, etc.) of a certain mineral (mineral species) with respect to geological time.

Examples: To occur, rarely or often, regularly or irregularly, in the historical course of the geological epochs; the empirical stability or instability (*Haltbarkeit* according to Niggli), of a certain mineral once formed; to belong to a certain geological epoch of younger or older age; radio-active minerals, as indicators of the absolute age of geological formations.

(*e*) *The Four General Physical Conditions of the Atmosphere, C-H-L-P*

The four general physical conditions of the atmosphere as perceived through the senses, together with the symbols that respectively represent them, are the following:

The *Caloric* of the atmosphere ..	C
The *Humidity* of the atmosphere ..	H
The *Light* of the atmosphere	L
The *Pressure* of the atmosphere ..	P

These can also be called, with certain restrictions, the *Four Constituent Factors of the Atmosphere as perceived through the Senses.* Their definitions are as follows:

The atmosphere surrounding the perceiving person is recognized immediately through sense-perception to be—

CONCEPT	NAME	SYMBOL
(i) cold or hot	Caloric	C
(ii) dry or wet	Humidity	H
(iii) bright or dark	Light	L
(iv) heavy or light	Pressure	P

These conditions may be conventionally quoted as 'C-H-L-P', or, following a suggestion made by Professor L. A. Cotton, in a mnemotechnic form: *CaLiPH* (caliph).

Each of these constituent factors of the atmosphere (in all of its degrees of variation) may be termed the *World of* (*atmospheric*) *Caloric*, the *World of* (*atmospheric*) *Humidity*, and so on, while the whole may be characterized and described as the *C-H-L-P–World.* The concept of the four general physical conditions of the atmosphere may be extended, at least partially, to the natural hydrosphere of the globe, 'as perceived through the senses'. The 'place' or 'locus' given to the four general physical conditions, or C-H-L-P–World, in the scheme of the Tetraktys is shown in Table 1; the reasons for this arrangement are indicated on pages 7–8.

The four general physical conditions of the atmosphere, as constituent elements of the System of the Categories of Natural Science, are called *Categorical Concepts*, because of the elementary, irreducible nature of these concepts based on immediate sensation. They are not categories in the sense of the definitions of that system, because all categories belonging to the Tetraktys,

both substantial and existential categories as well, are defined with respect to units of substance having boundaries perceivable through the senses. The atmosphere, surrounding the perceiving person, inasmuch as it is in a state of rest or equilibrium, appears 'homogeneous' to the different senses, because there is no possibility of choosing a 'unit' from it; or, in other words, the atmosphere in a state of rest does not exhibit inner boundaries to the senses.

Correspondingly, the general physical conditions of the atmosphere are not perceived, ordinarily, by means of the specialized sense-organs (except by the eye which 'sees' or 'feels' light even when the eyelids are closed), but by the whole of the nerve system of the body, particularly that of the skin. Therefore, most of the sense-perceptions made concerning the general physical conditions of the atmosphere are not distinctly localized in the perceiving body. It is to be noted that the four general physical conditions, or factors of the atmosphere (or hydrosphere), are prevalent in all parts of the atmosphere (or hydrosphere) neighbouring the surface of the world. They surround likewise the (natural) things or units perceived through the senses as well as the perceiving person.

Certain of these physical conditions or factors, in their different and variable degrees of intensity, may influence or modify certain of the properties of these (natural) things such as they appear to the senses. They may also influence or modify the sense-organs themselves during the process of sensation. These physical factors modify in degree, intensity, or quality, those characters of the natural things which are expressed by the 'Substantial Categories' or modes of substantial being of these things. For this reason, in order to obtain more distinct and more detailed information about the C-H-L-P-conditions of the atmosphere through simple sense-perception, an indirect way has to be used by studying their effects upon such natural units as are specifically, and at the same time more intensively, influenced or modified by certain conditions (or factors) of the atmosphere (or hydrosphere) and their respective changes.

One of the main tasks of the field geologist is to find out evidence for distinct conditions of Caloric, Humidity, Light and Pressure under which a given geological unit (for example, certain sedimentary strata, a certain mineral deposit, etc.) may have been formed in the past. By transferring the sense-experiences of the C-H-L-P–World of the atmosphere (and hydrosphere) to the units of the solidified crust of the earth, the geologist searches carefully for evidences of specific effects of the general physical conditions on units included in these geological formations, but characterized themselves by a higher degree of 'homogeneity' or individualization than the surrounding rocks. Such units specifically sensitive to changes in the C-H-L-P–conditions are organisms (fossils) and crystallized minerals, the latter being the most homogeneous natural units contained in the earth's crust.

In a recent publication (Cloos, 1947) the states of deformation and recrystallization of originally spherical oöids contained in sedimentary rocks have been carefully studied as indicating internal movements of these rocks under certain definite physical conditions. The observations made on these 'fossils', either crystals, or rests of organisms, or oöids, etc., are direct ones, and mostly correspond to the natural and near-natural working conditions as defined on page 6 and discussed on pages 20–22; but the conclusions on the C-H-L-P–conditions obtained from these observations are indirect ones. They therefore do not correspond strictly to the last paragraph (iv) of the definition of the natural conditions as given on page 6.

(*f*) *The Planes of Co-ordination in Space and the Axes of Succession in Time*

The plane S, called the *Plane of Co-ordination in Space*, an infinite plane of which only a finite part is plotted in Table 1 and Fig. 1, is only one out of an infinite number of infinite planes, S_m, S_n, S_o, etc., parallel to each other. Similarly, the axis T, called the *Axis of Succession in Time*, an infinite axis of which only a finite part is plotted in Table 1 and Fig. 1, is only one out of an infinite number of infinite axes, T_m, T_n, T_o, etc., parallel to each other. Since the plane S is perpendicular to the axis T, then all planes 'S' are perpendicular to all axes 'T'.

By convention, the axis T should always be drawn from the lower left to the upper right side of the projection of the Tetraktys, irrespective of the particular method of projection used. This orientation of the Tetraktys and the forms showing the geometrical pattern of the Tetraktys or its parts is called the *normal set-up* of the Tetraktys. The axes T are used for representing the time-relations of the different parts and elements of the Tetraktys. Any point t_n, t_o, etc., of this axis T lying on the right-hand side of a given point t_m represents an event or state of being which is *later* with respect to time than t_m.

For example, the category or mode of being called *To pass out of existence*, *cat. I—a*, referrin

to a given natural unit, U, is later in time than its other mode of being called *To come into existence*, *cat.I* $+a$. Similarly, the mode of being called *Taste*, *cat.IV* $-a$, of the given unit is later than its mode of being called *Smell*, *cat.IV* $+a$, as perceived through the senses. When compared with respect to time, the centre of the Sphere IV of the substantial categories lies to the right of the centre of the Sphere I on the axis T' joining these two centres. This expresses the fact that all modes of being embraced by the Sphere IV are perceived later (under natural conditions) than those embraced by the Sphere I, the former being perceived through the far-reaching senses of the sight, the hearing and the touch, before the latter can be perceived through the inner senses of the body.

The geometrical fact that the centres of the Spheres II and III of the substantial categories lie on the same plane, S, of co-ordination in space symbolizes the fact of the empirical reality of Nature that the modes of being embraced by these two Spheres are perceived as being co-ordinated with one another, or as existing beside each other. For example, *Proportions of Size*, *cat.* $II-a$, and *Lustre*, *cat.* $III-a$, of a given natural unit, U, are perceived at a time through the eye, by using different functions of this sense-organ at the same time. Similarly *Coldness*, *cat.* $III+b$, and *Weight*, *cat.* $III-b$, belonging to the same Sphere III, and lying on the same plane of co-ordination in space, are perceived at the same time by the sense of touch, for example of the hand, without interfering with each other.

Furthermore, any state at the moments t_n, t_o, etc., of a given unit, U, which is later than the state of the unit at the moment t_m, is represented by a certain point on the axis T lying on the right-hand side of t_m. Forms of the Tetraktys representing the different phenomena exhibited by a given unit U at different moments of time are therefore arranged with respect to their order of succession in time.

Part II. Outline of the Method Used for the Deduction of the Tetraktys

The Tetraktys being the system of the ultimate irreducible modes of being of natural things as perceived through the senses, we may expect that this system was deduced by an inductive method directly from a great mass of empirical data covering the whole of Natural Science. This is true, for instance, for the more specialized systems with which the Tetraktys has been compared, namely the *Tabular View of the External Characters of Minerals* by R. Jameson (1816), based on the famous work on the same subject by A. G. Werner; and the *Schedule for the Field Description of Sedimentary Rocks*, developed from the combined field experiences of American sedimentary petrologists (Goldman, 1922).

The method by which the Tetraktys was deduced is different in principle from the procedure illustrated by the examples mentioned, because it was deduced in the first place by a comparative study of the *meaning* of the common names of natural things. It would by far exceed the aim and the size of this Paper to present any details of this complex procedure. At least the outline of the method used, however, may be given here, because in several parts of this Paper reference had to be made to the mode of deduction.

The author first encountered this problem when in 1943–44 he began to investigate the question whether the minerals—or at least the so-called common minerals—could be arranged in a natural and comprehensive system of classification based on the 'meaning' of their common names, which were used or developed mainly by the practical miners or natural scientists of the past.

After an initial encouraging success in May 1944, which led immediately to the establishment of Sphere I of the Tetraktys in its present form, this investigation was extended to the study of the common names of natural things belonging to 'all' parts and phenomena of Nature as perceivable through the senses. Also the range of languages to be included in this vocabulary of names for natural things was considerably extended. The etymological data for these names were taken from standard works on etymology and Natural History. In many cases the meanings of the words were self-evident, or became evident when compared with detailed descriptions of the things designated by the names. The total number of the names studied exceeded 25,000, including about 1,800 common names of minerals, gems, stones, rocks, etc., or other objects of geology, mineralogy and mining.

These etymological studies were greatly supported by earlier personal experiences of the author during the years of his professorship at the University of Teheran, Iran. The lectures which were developed mainly from English and German literature, had to be delivered in French; but even the terminology of the geological sciences, mainly built up from Greek and Latin elements, had to be explained in French or Persian. Finally, the attempt was made to translate, for ordinary and field use, the common miner's terminology of European tradition (English, German, Swedish)

into basic Persian—a task which proved to be quite successful because of the comparatively simple structure of that language.

Expressing and describing things of so elementary a nature as minerals and their external characters in so many different languages is not a question of a 'translation' in the ordinary sense of the word. It merely means transferring *elementary concepts*, obtained from original sense-experience, directly into the basic words of the respective language. These elementary concepts, however, obtained directly from sense-perception, proved later to be nothing other than the ultimate irreducible modes of being, or, in other words, the categories of being of these things. Nevertheless the tremendous problem remained unsolved : how to find out their definite number (if any) and the ultimate principles separating these categories from one another.

The common names, expressed always in the basic words of each respective language (from which the names originated), and designating natural things as they are perceived through the unaided senses, can be considered to be the shortest possible grammatical forms of *synthetic judgments*. These judgments express the *differences* which discriminate the thing in question from those other things to which it appears similar and together with which it makes up a natural group of similar things in reality. Furthermore, since the things designated by these names are natural species, the judgments implied in the names refer to things which practically do not change their characters as a species during a man's life or even during the generations of men who gave and used these names. The 'truth' of these judgments, therefore, has been re-examined and confirmed by uncounted generations. It even appears that the names which survived this selective process of re-examination are those containing a maximum of truth.

Comparative studies of such considerable numbers of names of natural things in so many different languages revealed the fact that they are ordinarily used in two different functions—as synonyms and homonyms as well. A *homonym*, then, is to be defined as 'a word used for designating—at the same time—a multiplicity of things different from one another, but similar to one another with respect to certain particular properties expressed by the meaning, or complex of meanings, of that word'. On the other hand, a *synonym* is 'one out of a multiplicity of words used as names for one thing, but referring each to different discriminative characters, or groups of characters, of that thing'.

The sum of all homonyms and synonyms referring to a given sum of natural things represent numerous links, of complex character each, connecting mutually the *world of meanings* and the *world of perceptions* about the same sum of things, and this in the most diverse ways. If the number of the things embraced by the investigation, as well as the number of these connecting links, is very high, then the probability is high that all, or at least nearly all, combinations possible between the elements of these complex links may be represented among the great numbers of cases studied.

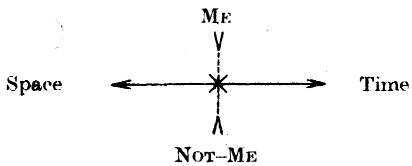
Checking against one another the meanings of the words used as names, and the phenomena of natural things as discernible through the senses, one first found that they can be attributed to a comparatively small number of *preliminary empirical categories of naming and being* of these things. Their number, however,—roughly a hundred—proved to be indefinite, and the precincts of these preliminary categories to be imperfectly separated from one another, or in other words, partially overlapping one another. This, again, is not compatible with the definition of a category as a concept of something ultimate and irreducible and at the same time not deducible from another category.

It may be added here that the preliminary categories of naming first obtained in the course of these studies were also constantly checked against the principles of grouping and classifying natural things as contained in the works on Natural History ; they were also compared with the principles used for the determination and discrimination of natural things as contained in the respective determinative tables, particularly in the tables for the determination of minerals.

In view of the imperfect nature of the preliminary categories first obtained, they were subjected, in a second stage of the investigation, to a rigorous analysis with respect to space and time as the most elementary empirical forms of all sense-experience. From this latter analysis the preliminary categories (of naming and of being of natural things as well) reduced themselves to the small and definite number shown in the Tetraktys. At the same time they proved to be perfectly separated from one another, inasmuch as the correct and final formulation of these categories in words was found. Thirdly, the space-time relations of these *ultimate modes of being* arranged them automatically in the spatial configuration shown in Table 1.

This spatial configuration called the Tetraktys (or, Pan-Tetraktys) is immediately based on the following scheme connecting the subject, ME, and the object, NOT-ME, of the process of sensation with the forms of space and time, as shown in

Figure 2. In this scheme, NOT-ME, or the *Natural Object to my senses*, denotes a unit of the material world of Nature; and ME stands for the totality of my senses as co-ordinated in my body. Thus, NOT–ME is that which presents itself to my senses and represents (under natural conditions) a unit natural thing or phenomenon possessed of a multiplicity of attributes or qualities capable of apprehension to the multiplicity of my senses.



The Natural Unit

Figure 2.
THOUGHT-SCHEME: THE FIRST ELEMENTS OF EMPIRICAL KNOWLEDGE.

The connexion of the unit *U* with the forms of space and time has already been discussed and geometrically symbolized by the fact that the centre *U* of the Tetraktys coincides with the point of intersection between the *Plane of Co-ordination in Space* and *the Axis of Succession in Time*. In addition to the thought-scheme shown in Fig. 2, this may symbolize the empirical fact that no sense-contact can be established between *the Perceiver*—ME— and *the Perceived*—NOT–ME (i.e., the unit of Nature) without going through the forms of apprehension, space and time. The Tetraktys, therefore, is in full accordance with Kant's fundamental doctrine, first presented in 1770, that *all* sense-experience goes through the forms of space and time.

Part III. Comparison of the Tetraktys with Some Other Fundamental Schemes of Natural Science

As pointed out on pages 6–7, the categorical character of the categories cannot be proved by a simple logical procedure, but only by illustrating them systematically by as many different examples as possible taken from the reality of Nature. Before this detailed illustration can be carried out, another way of making the System of the Categories of Natural Science understandable is by comparing this system with other similar schemes already established in Natural Science, which are of an empirical origin like the Tetraktys itself.

Any tabular view representing and connecting empirical facts of Natural Science is built up or grouped according to certain general concepts of a more or less categorical character. Comparison of these schemes with one another therefore reveals to what degree of abstraction these different schemes have been worked out; whether and to what degree they are homogeneous with respect to a certain number of fundamental principles; and what is their respective degree of completeness with respect to the total sum or group of facts that should be represented by these schemes. In the following paragraphs are presented some of the results already obtained from such comparisons.

(*a*) *R. Jameson's 'Tabular View of the External Characters of Minerals'*

The *Tabular View* of R. Jameson, contained in his *Treatise* (1816) on the same subject, is remarkable in mineralogical literature for two reasons. Firstly, because this work is closely related, with respect to its content and form of presentation, to the famous work on the same subject by A. G. Werner, the founder of modern Mineralogy. Secondly, it appears to be one of the last works of that period of time based on pure sense-perception, excluding practically any artificial means and apparatus from the study of minerals, even the application of the balance and the goniometer. The working conditions of this book therefore correspond perfectly to the Natural Conditions of Validity of the Tetraktys.

The external characters of minerals described and distinguished in this work cover, with only a few exceptions, all of the twenty-four Substantial Categories of the Tetraktys.

Analysis has proved that most of Jameson's 'General Generic External Characters' of minerals are nothing but 'Ultimate Modes of Being of Minerals as perceived through the Senses'. In other words, they *are* 'Categories of Being of Minerals', as will be shown in a special publication.

On the contrary, the order of connexion of these characters which are arranged, in the *Tabular View* mentioned, with respect to the five senses, and their relationships of co-ordination and subordination, are by no means perfect. There is no arrangement of these characters with respect to space and time, and only very incomplete mention is made of the changes of the characters of minerals in dependence upon the change in the General Physical Conditions.

(*b*) *The Schedule for the Field Description of Sedimentary Rocks*

Only brief mention may be made here of the comparison of the Tetraktys with the *Schedule*

for the Field Description of Sedimentary Rocks by Goldman (1922), and its modification by Twenhofel (1926); cf. also Kemp Grout (1940, pages 146–7). It will be dealt with in a special publication. The comparison carried out in the address mentioned above (Koch, 1948) proved that the characters of sedimentary rocks distinguished in this *Schedule* are close to the categories distinguished in the Tetraktys. The *Schedule* shows no arrangement of its features with respect to space and time, but it contains a considerable number of characters and features of sedimentary rocks referring to space and time. The authors of the *Schedule* admit that they do not consider it as in any way final or complete This is partially due to the fact that the question of the 'Natural Unit', being of fundamental importance for the construction and use and interconnexions of such schedules, was not yet sufficiently studied at the time that the *Schedule for Sedimentary Rocks* was first compiled. (See *Committee of American State Geologists*, 1933; Glaessner, *et al.* 1948; cf. also pages 5, 23, 26).

(c) *Aristotle's Table of Categories*

The discussion of a new system of categories necessarily leads to a comparison with Aristotle's *Table of Categories*. This is not only because Aristotle is the founder of the doctrine of the categories, who first gave them the name which is still in use, but mainly because the Aristotelian system still appears to be the most universal system of categories ever worked out in the history of science and philosophy.

A preliminary comparison of the Tetraktys with Aristotle's *Table* was carried out in such a way that only the applications of the Aristotelian categories to the natural things were taken into consideration. This selection of the examples pertaining to Natural Science appears to be fully compatible with Aristotle's fundamental principle of philosophical procedure: πρότερον τῇ φύσει (proteron te physei—'first by nature'). Not only most of the examples given for the illustration of his categories are taken from the world of Nature, but they are also almost always quoted in the first place.

The comparison was based mainly on the text of the Oxford translation (Ross, 1908–31), but in all decisive questions reference was made to the original Greek texts (Bekker, 1837). The classical investigation of Trendelenburg (1846) into the origin of the Aristotelian categories was taken as a guide to a careful study of the data contained in Aristotle's *Essay on the Categories*. In addition to this, numerous examples contained in Aristotle's main works on Natural History were subjected to an analysis similar to that used for the deduction of the Tetraktys. By these studies a considerable number of additional data for the elucidation of the Aristotelian doctrine were found, which were either not mentioned or not taken into consideration in Trendelenburg's theory of the 'grammatical' origin of the Aristotelian categories.

The comparison revealed so many parallels, coincidences and similarities existing between the Tetraktys and the Aristotelian system of categories that only some of the main results of these preliminary studies can be presented here. A more detailed discussion of these results will be made in a special publication. The Aristotelian doctrine of the categories, inasmuch as it is illustrated and expressed by the numerous examples taken from the world of natural things, exhibits more and closer relationships with the Tetraktys or System of the Categories of Natural Science than any other scheme of categories the author could discover in modern literature. These parallels are particularly close with regard to the interrelationships of these categories, i.e. the relations between their genera, sub-genera and species.

All those concepts which are called 'categories proper' in Aristotle's works, and are designated at the same time by the word γένη (*gene*—'genera') of categories, show the following parallels with the parts and elements of the Tetraktys:

The Undifferentiated Self-existent Natural Unit, U, of the Tetraktys closely corresponds with Aristotle's first category called οὐσία (*ousia*), ordinarily translated by 'Substance'. It is that category of Aristotle's which is presupposed to all others, and whereof they are the συμβεβηκότα (*symbebekota*), ordinarily translated by 'Accidents', the latter corresponding to the Differentiations of the unit, U, as mentioned on page 9.

Aristotle's genera called 'Quantity', 'Relation', and 'Quality' represent the parallels to the Spheres of Substantial Categories *I*, *II*, and *III*+*IV* combined, the combination of the last corresponding to the 'Affective Qualities' of Old Greek Philosophy (see page 12). The genera called 'Place', 'Time', and 'Position' have their parallels in the General Categories of Existential Being as follows: *catg.* $(U{:::}U')_S$ *catg.* $(U{:::}U')_T$, and the categories *catg.* $U{:::}S$+*catg.* $U{:::}T$ combined. The Aristotelian category κεῖσθαι (*keisthai*), ordinarily translated by 'Position' or 'Posture', inasmuch as it refers to natural things, appears to designate Positional Character with respect to both space *and* time, as illustrated by examples given.

The Aristotelian categories 'Action' and 'Passivity' have their parallels in the Tetraktys in the categories *cat.* $I-c$ and *cat.* $I+c$ respectively. Numerous so-called 'Species of Categories' of the Aristotelian doctrine as well as several of its 'Categorical Concepts', for example the 'movements' called 'Genesis' and 'Destruction', correspond closely with Substantial Categories of the Tetraktys, the examples mentioned being close parallels to the categories *cat.* $I+a$ and *cat.* $I-a$ of that system.

Even such details as the subdivision of the Aristotelian genus 'Quantity' into the sub-genera 'Continuous' and 'Discrete' quantity, have their parallels in the Tetrakyts: the former corresponds to the sub-group or 'Half-Sphere' embracing the categories *cat.* $II+a$, *cat.* $II+b$, *cat.* $II+c$, the latter to the sub-group consisting of *cat.* $II-a$, *cat.* $II-b$, *cat.* $II-c$. The so-called 'Contraries' included in the Aristotelian categories have their parallel in such Differences as 'heavy or light' included in *cat.* $III-b$, *Weight*; or in 'bright or dull' included in *cat.* $III-a$, *Lustre*; and so forth (see pages 10–11).

Part IV. Application of the Tetraktys to the Geological Sciences

1. Natural, Near-natural, and Artificial Working Conditions of Geological and Mineralogical Investigations

In discussing the application of the Tetraktys to geological investigations, consideration must first be given to the conditions under which these investigations are ordinarily carried out: from this consideration it will immediately become evident to what extent such conditions may correspond to the Natural Conditions of Validity of the Tetraktys, and to what degree they may coincide.

For this purpose the comparison of the Tetraktys with the *Schedule for the Field Description of Sedimentary Rocks* (page 2) was extended also to the conditions prevailing in the geological field work embraced by this schedule. The comparison proved that with two minor exceptions (the use of instruments in measuring the shape of pebbles and the use of the compass), the schedule contained no feature and involved no method which was not compatible with the Natural Conditions as defined on page 6.

With regard to the measurement of the *shape of pebbles*, the following remarks made in the introductory notes to the schedule may be quoted (Goldman, 1922, page 257):

> 'Although Mr. Wentworth has devised instruments for making these measurements, a consultation with him showed that it is possible to make rather accurate estimates of the dimensions to be measured.'

Apparently these estimates are to be based on observations made by the unaided senses, i.e. under strictly natural conditions.

The same could be said, obviously, about the use of the *compass* for measuring the orientation, with respect to space, of certain geological structures. The needle of the compass is sensitive to the terrestrial magnetic field, which is not perceivable through the senses of the human body. Consequently, magnetic phenomena as such are not represented in the scheme of the Tetraktys. Handling the compass and making the readings, however, are both carried out by means of, and under close observation through, the ordinary senses. In applying the compass for geological purposes we make use of the empirical fact that the compass needle always points to a certain direction which could be otherwise defined by positions or movements of celestial bodies (viz. the sun, stars) observed by the naked eye.

The conditions under which the geological phenomena, embraced by the schedule mentioned, are observed in the field, therefore coincide in practically all points with the Natural Conditions of Validity of the Tetraktys. The features themselves belong to lithology, mineralogy, palaeontology, structural geology, etc.: covering most diverse kinds of objects of the geological sciences. It is therefore justifiable to state that the ordinary field work of the geologist, palaeontologist, or mineral prospector, is carried out under the described natural conditions.

Even in cases where a certain geological problem is to be dealt with by *geophysical* methods, the application of such methods is almost always based on the results of previous geological field work carried out under the natural conditions mentioned above. The geophysical methods themselves, consisting either of measurements of the electrical conductivity of the underground, or of magnetic or mass effects, as well as the complicated mathematical calculations required for computing the final results of these measurements, are obviously made under such working conditions as were defined as Artificial Working Conditions on pages 6 and 22.

On the other hand, in order to represent the results of geophysical measurements in terms of geology, they must again be expressed in the ordinary categorical terms of the Tetraktys covering the whole material world of Nature as perceivable through the senses. In the geophysical investiga-

tion of a deep-seated ore body, for example, this may be carried out in the following way:

> The natural unit of substance (i.e., the ore body) was found to have certain proportions of size, *cat. II—a*, a certain average density, *cat. III—b*, a certain orientation in space (horizontal, inclined, etc.), *catg. U:::S*, at a certain depth from the surface, and so forth. Apparently, the results obtainable from a purely geophysical investigation of an ore body at depth are much less complete with respect to the substantial categories than those obtained from ordinary geological field investigations of surface features. The results of these geophysical investigations, therefore, have to be completed by the additional investigation of drill cores or of rock and ore specimens obtained from shafts, tunnels, etc. These investigations are carried out either under the field conditions as described above or in the geological laboratory.

The question therefore arises whether, and to what degree, the ordinary methods of investigation used in the geological and mineralogical laboratory correspond to the Natural Conditions. According to the definitions of the sciences of geology and mineralogy, the objects of these sciences are natural units of the upper parts of the earth's crust, coinciding in this important point with the Natural Conditions as defined above. With regard to the ordinary methods of investigation used in the geological laboratory, we must first define what will be called the *Near-Natural Working Conditions*.

These are as follows:

> Mineralogical, petrographical, etc., investigations of natural units of the earth's crust are said to be carried out under *near-natural* conditions when the main part of the operations is carried out under the control of the ordinary senses, or is carried out to an essential degree by means of the ordinary senses; and when the final results are obtained from simple reasoning about the observations made, not from complicated mathematical calculations.

When compared with these Near-Natural Conditions, the following methods of investigation, or the simple use of the following instruments for geological and mineralogical investigations, obviously correspond to these near-natural conditions:

> The use of the compass as described above; the use of the balance for determination of specific gravity; the magnifying glass and the ordinary microscope; the use of the blowpipe and of simple chemical tests for the determination of minerals and rocks.

This may be illustrated by a few examples dealt with in some detail:

The use of the *balance* for the determination of the specific gravity of a given mineral specimen (instead of estimating it less accurately by means of the 'Weighing Touch') replaces the observation of the *mode of being, cat. III—b*, of the specimen by observations on *orientation in space, catg. U:::S*, of the scales or the needle of the balance used for this purpose. The balance itself, as well as the specimen tested, are under close observation through the ordinary senses during the preparation of the specimen and the weighing operations themselves.

The use of the *blowpipe* for mineral determination means the production (under artificial circumstances) of the heat necessary to cause the specimen or unit, U, tested to *pass out of existence, cat. I—a*, and to cause the *coming into existence, cat. I+a*, of another unit U' (or units U', U'', etc.) instead. The observations themselves are made almost exclusively by means of the unaided senses (eyes, ears, nose, etc.), i.e. under natural conditions. The ordinary close distance of the specimen tested, from the perceiving sense-organs, corresponds to optimum conditions of sharp and complete observations through these senses. Subjecting the specimen tested to the conditions of either the oxidizing or reducing flame (the colours and parts of the flame of the blowpipe providing visual control), corresponds to *catg.* $(U:::U_m)_S$ and *catg.* $(U:::U_n)_S$, representing the unit U in association with oxidizing agents U_m or reducing agents U_n, etc.

Similarly, carrying out simple *chemical reactions* in the 'wet' state (i.e. under certain conditions of Humidity, H), means to *associate in space, catg.* $(U:::U_m)_S$, the unknown mineral unit U with other units U_m, U_n, etc., of known substances called reagents, and to observe the phenomena produced by this association, mostly in dependence upon different states of Caloric, C. The phenomena thus produced may again correspond to the category *cat. I—a* of the unit U given, and the category *cat. I+a* of the new units U', U'', etc., which appear in its stead. The combination of the two categories mentioned, and their connexion in the order of sequence

$$(cat.\ I-a).U \rightarrow (cat.\ I+a).U',\ U'',\ \text{etc.}$$

therefore represents the transformation of one unit U of substance into another unit U' of substance, or other units U', U'', etc., of substance. In other words, this combination and connexion of categories, or *Equation of Categories*, is to be

considered as the expression of a *chemical reaction* in terms of the Categories of Natural Science.

Additional statements regarding the conditions of Caloric, Humidity, etc., then represent the General Physical Conditions of these reactions in terms of the Tetraktys. In this connexion it is interesting to mention that in a recent publication on blowpipe analysis (Smith, 1946) it was recommended that blowpipe tests be carried out both in ordinary and ultra-violet light, in order to observe the characteristic phenomena of fluorescence connected with the ordinary phenomena and reactions. When expressed in terms of the Tetraktys, this means to replace the World of Ordinary (visible) Light, L, by another World of Ultra-violet Light, L′, which, although not visible itself to the human eye, causes visible phenomena of fluorescence of the minerals tested. This change of the World of Light, combined with changes in Caloric and Humidity, represents a further valuable contribution to the discriminative power of blowpipe analysis.

The examples given in the preceding paragraphs may be sufficient to show that the Tetraktys, as the System of the Categories of Natural Science, is applicable in principle to the process of qualitative chemical analysis carried out under the control of the unaided senses, i.e. under natural and near-natural conditions. The question remains whether the conditions of mineral determination by means of the *polarizing microscope*, having such an important place in all petrographical and mineralogical investigations, may be included in these near-natural working conditions or not.

Obviously, the ordinary objects of the investigations are natural units—minerals, rocks, ores. The determinations are carried out on either transparent or opaque objects, using plane-polarized light. Whether a certain artificial source of light, or an instrument such as the Nicol prism, produces ordinary or plane-polarized light, cannot be recognized in one single act by means of the unaided eyes. The phenomena of 'light' observed through the polarizing microscope, however, closely correspond to those made in ordinary light, i.e. they embrace observations of *Colour, cat. III+a*, and *Intensity, cat. III−a*, in dependence upon a constant or changing World of Light, L, in which these observations are made.

In addition to these observations which are identical with those made in ordinary light when determining the 'external characters' *Colour* and *Lustre* of minerals, the use of the polarizing microscope requires connexion of these modes of being of the unit tested with others, as follows:

> Traces of cleavage; contours of crystals; twin lamellae—all embraced by the category *Constituent part of shape, cat. II+c.*

Furthermore, the *Orientation with respect to space, catg. U:::S*, of all of these phenomena with respect to each other as well as with respect to certain particular directions of the Nicol prisms and the microscope, has to be determined. Finally, the thickness of the thin-section examined, and the parallelism of its upper and lower surfaces, have to be taken into consideration.

The determination of the mineral unit examined then consists in observing that a certain number of certain modes or categories of being of the unit are connected in a certain distinct manner, discriminating the unit tested from any other similar unit of another substance. This combination and interconnexion of different modes of being of the same unit can immediately be illustrated by plotting on forms which show the pattern of the Tetraktys. The process of determination of minerals by means of the polarizing microscope therefore may be said to correspond to the near-natural conditions.

On the contrary, the determination of crystalline minerals by means of *X-ray analysis* cannot be included in the natural or near-natural working conditions. This is because the main essential phenomenon, the diffraction of the X-rays passing through the crystal, cannot be perceived directly by means of the eyes, except when they fall on a fluorescent screen or on a photographic film which has to be developed before the effects of the diffracted X-rays can be seen. Even then, however, the connexion between the phenomena recorded by these artificial means (screen and photographic film) and the 'reality of Nature', i.e. the regular arrangement of the atoms, etc., in space, can be recognized only by means of complicated mathematical formulae and calculations, the use of which was excluded from the natural conditions.

2. The Tetraktys as a Basis for Schedules for Geological Field Investigations

(a) *Discussion of Some Principles Underlying the Construction and Use of Schedules based upon the Tetraktys*

When considering original field work as the basis of the geologist's activity and the principal source of the progress of geological science, the successful application of the Tetraktys to this type of work may be considered as its crucial test. For this reason, in the address mentioned above (Koch, 1948), the Tetraktys was compared in every detail with the *Schedule for the Field Descrip-*

tion of Sedimentary Rocks compiled by a committee of American sedimentary petrologists during the years 1918 to 1922 and accepted by the U.S. Geological Survey (Goldman, 1922).

Some of the main results of this address are contained in the summary published in This JOURNAL (Koch, 1948). Further data are given in the Introduction of this paper, pages 2–3, and on pages 18–19. In addition to the facts already quoted, the comparison of the two schemes revealed five critical questions which represent the main problems connected with the construction and use of schedules for geological field investigations. These points are :

(i) What shall be presented in the schedule ?

(ii) In what order of grouping and interconnexion shall the facts be presented ?

(iii) Shall the schedule refer only to one self-existent natural unit or to several units at once ?

(iv) How shall units connected with one another in the reality of Nature be separated in their representation by the schedules ?

(v) How shall the natural interconnexion of these units be expressed in their representation in separate schedules ?

The following answers to these questions are given from the working principles developed in connexion with the Tetraktys :

(i) In order to assure the highest degree of completeness of geological field work, every obtainable observation of the natural unit selected for the investigation should have a *place*, and should be plotted in the schedule. No possible observation should be excluded for the reason of certain prejudices or of an anticipated *importance* and *non-importance* of the phenomena observable. The author fully agrees in this regard with the recommendations given by Twenhofel (1st ed., 1926, page 621 ; particularly 2nd ed., 1932, page 873).

(ii) The principle of grouping in the construction of the schedules should be the most natural possible, ultimately based on the forms of apprehension, space and time, as the most fundamental forms of all sense-experience. In this connexion it should be remembered that the geologist's task is, commencing with the observation of the spatial interconnexion (by association and mutual inclusion) of natural units of the earth's crust, to reveal the temporal order of their formation as well as the physical conditions under which these processes may have taken place in the past.

The Tetraktys, in the spatial arrangement of its parts, shows all phenomena exhibited by a certain natural unit in connexion with, and in dependence upon, the four general physical conditions of the C-H-L-P–World, ultimately grouped with respect to space and time as the highest principles of grouping.

(iii) In order to illustrate the third point, a schedule is given in Table 3, entitled *Schedule for the Field Investigation of a Volcanic Neck or Neck Formation.* This schedule is based entirely on field investigations carr d out by the author while making volcanological studies in the Eifel Mountains (Koch, 1933) from 1931 to 1936, and later in Persia. In this connexion, only the question of the *unit* or *units*, to which the schedule refers, may be dealt with here. Additional data and explanations about this schedule will be given in a special publication.

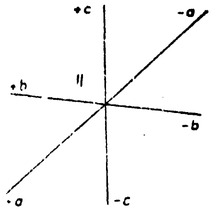
The natural unit, U, to which the data of this schedule refer, in the first place, is an eruptive body filling a volcanic neck. As shown, however, by the data given under the heading *cat.* $II+c$, *Constituent part of shape* (i.e. the shape of that eruptive body), the majority of these data refer to layers, blocks, pillars, columns, platy slabs, etc., into which the eruptive body as a whole may be divided. Each of these parts of the whole unit U may be made, if desirable, the centre or unit, U', U'', etc., of another schedule or of other schedules, F', F'', etc., representing every observable phenomenon of this sub-unit. All of these sub-units, U', U'', etc., have the same categorical relationship with respect to the main unit, U, i.e. being constituent parts of it ; and are distinguished from one another mainly by the fact of being sub-units of a different order with respect to the main unit. They therefore can be dealt with in the main schedule under the same heading, i.e. *cat.* $II+c$. It is recommended, however, that these data referring to the different sub-units should be detailed in such an order of sequence as corresponds at the same time to the natural order of sequence of these sub-units in the division of the main unit (i.e. the eruptive body) represented in the schedule.

(iv) In the same schedule, other units, U', etc., are indicated, which are more independent

The eruptive body divided into beds, layers, pillars, columns, platy slabs, tabular elements; or in irregular blocks; by joints, lamination planes, etc.; structure, texture, of the rock; layers of different structure and composition; veins, products of magmatic differentiation

The eruptive body containing holes, cavities, air channels, air bubbles, pores; vughs, mineral druses; or inclusions of blocks or fragments of eruptive or country rocks; inclusions of fragments of minerals, etc.

Shape or form of the eruptive body as a part of the earth's surface—conical, or a flat hill, knob, mountain ridge, etc.; shape of the sub-crustal body, etc.



Size and proportions of the eruptive body; measurements of the extent in the different directions; height, circumference, diameter, etc.

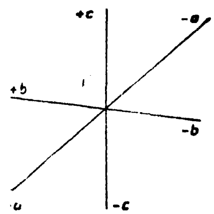
The eruptive body as one unit of two or several eruptive bodies forming a higher unit, having the same feeding channel; alignment of several necks along the same tectonic fissure; etc.

Distinct number of the edges of the columns into which the eruptive body is divided—five-edged, six-edged columns

The eruptive body exposed, or having been exposed, to forces acting upon it—tectonic movements, earthquakes, landslides; to agents of denudation—wind, rain, etc.; desert polish

The eruptive body distinguished by a shape, or other features, representing better the ideal shape, etc., of a volcanic neck than the majority of the other bodies belonging to the same eruptive province; the body selected for characteristic photographs, sketches, etc.

The act by which the eruptive body came into existence—upthrust of magma, by explosion or by quiet flow; the process of forcing its way through the country rocks, etc.



The process by which the eruptive body passes out of its existence—destruction by denudation, weathering, etc.; destruction by artificial means—quarries, railway cuttings, etc.

The eruptive body having caused contact phenomena in the surrounding tuff-mantle or country rock; absence of contact phenomena is to be noted also; magnetic influence on compass

Reaction of the eruptive body, or of the rock composing it, to forces acting upon it—spalling due to insolation or frost; shattering, sounding, emission of sparks, under hammer blows; odour under hammer blows

Phenomena related to the C-H-L-P–Conditions

(*a*) Indications as to *heat*-conditions of the rock-formation from the magmatic process (deduced from the mineral composition and from contact phenomena); slow or rapid cooling process—occurrence of volcanic glass
(*b*) Heat conditions of secondary (deuteric) processes
(*c*) Heat conditions of the weathering processes depending upon climatic conditions, existing and in the past

(*a*) No effect of *light* on primary magmatic process is known
(*b*) (Effects of radio-active radiation: effects are of microscopic dimensions only)
(*c*) Bleaching of certain kinds of 'greenstone' on fresh surfaces of fracture, when exposed to the sunlight

CALORIC | LIGHT

HUMIDITY | PRESSURE

(*a*) Indications as to the *humidity* contained in the magma; 'dry' and 'wet' magmas; occurrence of hornblende, zeolites, in the rock
(*b*) Humidity (water content) of the country rock affected by the magmatic contact; mutual reactions and effects of escaping water
(*c*) Humidity conditions of the deuteric processes—zeolithization, serpentinization, etc.
(*d*) Humidity of the weathering process existing and in in the past (palaeoclimatic indications)

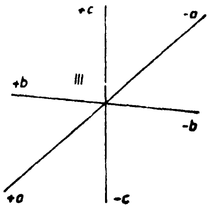
(*a*) Phenomena indicating higher or lower *pressure* prevalent during the magmatic and crystallization processes; dependence of these phenomena upon depth of the part of the neck actually exposed; minerals indicating formation at depth—biotite, hornblende, etc., in eruptive rocks
(*b*) Phenomena indicating tectonic pressure, after solidification of the eruptive body—partings, shearing slickensides, faulting, brecciation, etc.

Table 3. SCHEDULE FOR THE FIELD INVESTIGATION

Character of the surface of the eruptive body and its constituent parts—surfaces rough or smooth; surface of fracture planes, or planes of divisibility; of joints, fissures, cracks, etc.; surface in fresh or weathered state

Coldness of the rock tested by the 'lasting' touch; coldness on planes of fracture, on joints, weathered surfaces

Colour of the rock, in fresh or weathered state—on joints, fissures; at certain distance from the surface within the eruptive body; in dry or wet state; change of the shade of colour in different light, in different seasons; colour of the surface when breathed on



Lustre of the surface of the eruptive body and its constituent parts; of fracture planes, planes of divisibility, joints; lustre of the weathered surfaces

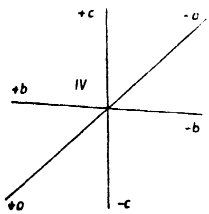
The rock appearing 'heavy' or 'light' to the 'weighing' touch; specific gravity of the rock and of its inclusions (olivine, etc.)

Stickiness of the rock surface: on joints, slickensides; stickiness of the products of weathering (soils), in wet state; cf. the hardening, cracking of the products of weathering, when dried up

Toughness or brittleness of the rock substance, tested between the teeth, or on a sharp edge pressed against steel; dependence on dry or wet state; dependence upon distance from surface; in isolated blocks or boulders

Rock-dust provoking phenomena of silicosis; general feeling of a person affected by a dusted lung

Smell of the rock, fresh or weathered, dry or wet; when breathed upon; when heated; odour produced under hammer blows



Taste of the (powdered) rock, or of fresh or weathered surface; taste of the products of weathering

Effects (pains) caused by tiny rock-splinters penetrating the skin (cf. the effect of handling wollastonite or asbestos rock, or of handling rock-salt, etc.)

Adhesiveness to the tongue, of the rock in fresh or weathered state; of the rock *in situ*, or of isolated blocks; different adhesiveness on fracture planes, on joints, etc.; soluble inclusions

Phenomena related to the General Existential Categories

Space and Time Relations

Association of tuff with the eruptive body; tuff filling parts and pockets of the neck, or the funnel
Neck-filling breccia—lithological composition giving information about the lithological composition of the old land-surface at the time of the break-through of the neck
Connexion of the eruptive body with deuteric volcanic or post-magmatic phenomena—mineral springs, carbon dioxide exhalations; deposition of iron hydroxide, etc.

Relations in time, of the eruptive body with other bodies belonging to the same or other formations
Relation of the phenomena caused by the volcanic break-through, with tectonic phenomena of the country rock

Connexion in time, of the magmatic activity with tectonic movements, etc.

$$\frac{catg.\ (U:::U')_S}{catg.\ U:::S} \quad \Bigg| \quad \frac{catg.\ (U:::U')_T}{catg.\ U:::T}$$

General character of the eruptive rock occurrences with respect to space—isolated or lined-up occurrence, etc.

Geographical significance, morphological appearance of the single necks as well as of the whole neck formation; spatial relationships (in level) to occurrences of older and younger eruptive rocks

General relation to time (or in time) of the magmatic activity of the neck formation—simultaneous, continuous, intermittent; interrupted by periods of magmatic inactivity
Volcanic activity interrupted by periods of denudation, etc.

OF A VOLCANIC NECK OR NECK FORMATION

of the eruptive body than are the sub-units mentioned above; or have, in other words, a higher degree of self-existence. Such units, for example, are the tuff associated with the eruptive body, *catg.* $(U:::U')_S$, and the 'Inclusions of fragments of sedimentary rocks', etc., included in the eruptive body, *cat.* $II+b$. In case that, in the course of a detailed investigation of a unit, U, one or more of its sub-units, U', U'', etc., or other self-existent units U_m, U_n, etc., associated or otherwise connected with U, should be studied in more detail, then each of these units will be made the centre of a new schedule F', F'', etc., or F_m, F_n, etc., representing all data referring to these new units of investigation.

The American authors, in their schedule mentioned above, attempted to represent all 'main' phenomena referring to four (or even more) well-distinct or self-existent units at once, namely:

> The sedimentary rocks themselves; the inorganic constituents; the organic constituents (fossils); the concretions.

Additional data refer to the cement of the rock, and to the higher unit of the sedimentary formation to which the rock belongs, as two additional units embraced by that schedule. On the other hand, essential phenomena (i.e. modes of being) of all of these units were omitted from the schedule in order to prevent the schedule becoming too large and too difficult to handle.

The difficulties encountered by the American authors of the *Schedule for the Description of Sedimentary Rocks* have been completely eliminated by the development and use of the Tetraktys. There is no necessity for 'searching' or trying out the 'right' type of schedules adapted to the description of units of very different nature, because the Tetraktys is the universal basis of them all. There is also no necessity of disturbing the clear set-up of a certain schedule by filling it with detailed data pertaining to different units, because all of these units can be represented each by a separate schedule.

(v) The important question remains: How to express in these separate schedules the relationships of these different units connected with each other in the reality of Nature, but represented separately? This problem is solved in the following way in the schedules developed on the basis of the Tetraktys:

> According to the definition of the different categories given on pages 9–14, the scheme of the Tetraktys contains all categories necessary for the expression of the different possible interconnexions of two or more natural units, U', U'', etc., or U_m, U_n, etc. This may be illustrated by examples taken from the *Schedule for the Field Investigation of a Volcanic Neck or Neck Formation.*

Examples of the connexion of a volcanic neck with tuff associated with it and with rock fragments included, have been dealt with above. The eruptive body is connected with other eruptive bodies occurring in the same area or geographical unit by *catg.* $(U:::U')_S$; but should these other eruptive bodies belong to different periods of volcanic activity, the particular temporal relationship is expressed by *catg.* $(U:::U')_T$. Finally, in order to take an example from another field of geology, a mass of granite and the alluvials deposited in a creek which cuts through it are connected in the first place by the categories *cat.* $I-a$, *To pass out of existence* (by the process of weathering, etc.) and *cat.* $I+a$, *To come into existence* (by deposition from running waters, etc.). In addition to these genetic relationships of the two units connected by Nature, other temporal or spatial relationships may be expressed by the categories *catg.* $(U:::U')_S$, *catg.* $(U:::U')_T$, *cat.* $U:::S$; the last referring, for example, to the different levels (terraces, old land-surfaces, etc.) with which these alluvials may be found associated.

In the practical case of an actual geological field investigation, the use of forms referring to different geological units, or even of whole sets of such forms, is as follows:

> In each form (for example, F) representing one of the natural units connected with distinct other geological units in a definite way, that particular category, or those particular categories, by which the first unit, U, is connected with any other of the units, U', U'', etc., is *marked* by the name or number or symbol given to the respective other unit in the field notebook. A glance on such a 'marked' form immediately reveals whether there exist other filled-in forms (F', F'', etc.)

connected with it, or not. The forms themselves can be kept in any order—chronological, alphabetical, etc.

It was shown in the comparison of the American schedule with the Tetraktys, that any object of geological field observation—whole sedimentary formations, smaller rock-units, minerals, concretions, crystals, fossils, etc.—can each be represented with the multiplicity of their respective phenomena. The application of the Tetraktys therefore appears independent of the absolute size and nature of the natural unit represented in it. This is confirmed by the results of a detailed field investigation on *desert varnish* carried out in different parts of the deserts of the Iranian Plateau. The observations, when plotted in a schedule according to the scheme of the Tetraktys, covered the majority of its categories; and the *blanks* left on the schedule immediately indicate those observations which have to be carried out in the future in order to complete our knowledge about this highly complex phenomenon, which proved to be particularly sensitive to changes in the C-H-L-P-conditions of the desert. The schedule was presented on the occasion of the address mentioned above (Koch, 1948).

It may be seen from the numerous examples of application which have been mentioned that schedules—or even whole sets of schedules—can also be developed and used for the most complete and systematic study of mineral or ore deposits. This may be illustrated by the example of an ore deposit of the paramagmatic type. At least three, and usually four, different schedules will be required for this purpose, corresponding to the four main units connected in that type of deposit: the country rock; the magmatic body; the ore body; and the contact rocks. The examples dealt with in the foregoing paragraphs have made it clear that the schedules representing each of these different natural units of the ore deposit can be connected with each other in such ways that any relationships of the natural units in the reality are adequately represented in the respective schedules.

The author is fully aware that a considerable mass of detailed work, theoretical as well as in the field, is still to be done in order to adapt the use of the Tetraktys to the requirements of geological investigations of any kind of object. Nevertheless, it may be seen from the discussions contained in this section, that the five critical questions representing the problems of the construction and use of schedules for geological field investigations have been solved in principle. This was carried out with the highest degree of generalization possible by the development of the Tetraktys and the working principles connected therewith.

(*b*) *The Question of the Combinations Possible between the Elements of the Tetraktys*

A second problem of fundamental importance connected with the construction and use of schedules for geological field investigations is the question of the number of *characters* to be observed and recorded, as well as the number of their relations. The author fully agrees with the emphasis laid by the American authors on this point, and desires to quote in full the main sentences referring to it (Goldman, 1922, p. 254):

> 'The characters which could be recognized in any sedimentary rock are numberless . . . What is true of the wide range of characters to be observed is even more true of the relations of characters. These are necessarily more numerous than the characters and their determination much more important; for most, if not all of the progress of knowledge is based essentially on the discovery of new relations between facts . . . While the user of the schedule should be reminded constantly to look for relationships, the impression should be avoided that in this or any respect the schedule may be relied on as final or complete . . .'

And later on:

> 'The feature in the schedule which is considered most important and fundamental is the emphasis on quantitative results . . .'

The adequate way of attacking this problem of the schedules is to subject them to the methods of the calculation of the combinations, in order to find out the number of combinations possible between a given number of distinct and independent elements having a certain order of arrangement in the schedules.

When applied to the original schedules developed by the committee, and to that form of it reproduced by Twenhofel (1926) as 'slightly modified' from the original, the calculations of the combinations possible between the elements of these schedules will provide no results of general validity. First, because these schedules do not reveal to what degree their 'elements' are independent from one another. Secondly, because the number of these elements is not a definite one, as shown by a comparison between the two schedules. It is also not clear in all instances to what features the numerous 'etc.' contained in them may refer. Thirdly, the main principles of division of the two schedules, when compared with one another, prove to be essentially

different: therefore the schedules do not correspond with respect to the relationships of co-ordination and sub-ordination of their main parts.

On the contrary, the elements of the Tetraktys, according to the definition of the categories, are strictly independent and not deducible from one another. The number of these elements is distinct and limited. The division of these elements in groups, sub-groups, etc., is definite. Furthermore, the number of these categories and categorical concepts was found to be surprisingly small; and, finally, their arrangement in groups, etc., highly symmetrical. The methods of the calculation of the combinations can therefore be immediately applied to the Tetraktys. The results of these calculations will be valid also for the different applications of the scheme of the Tetraktys, for example to the schedules built up on the basis of the Tetraktys.

A first informal mathematical study on the combinations possible between the elements of the Tetraktys has already been carried out by Professor L. A. Cotton (unpublished). According to these preliminary studies, the number of the binary and ternary combinations between the twenty-four substantial categories is by no means 'numberless', but of the order of hundreds and thousands, respectively. On the other hand, when considering the practical application of the Tetraktys to the systematic study and representation of the 'relations' or 'combinations' between these categories of being of natural things, for example of geological phenomena, these numbers appear so high as to require careful and methodical procedure for these studies.

A number of the phenomena dealt with by the geological sciences prove to be of a complex nature when expressed in terms of the categories of the Tetraktys. For example, *hardness*, in the sense of the hardness of minerals as revealed by the ordinary scratching test, or the Brinell method, is by no means a 'simple' phenomenon but a composite one, as was pointed out by Niggli (1920). Hardness, when expressed in terms of the categories of the Tetraktys, proves to be even a concept of fairly high complexity. Other phenomena of such a complex nature are, for example, symmetry, cleavage, soapy touch; structure, and texture of rocks; or weather, climate, etc. A way to the systematic study of these complex phenomena and their definitions appears to be opened by the use of the Tetraktys.

In the practical applications of the Tetraktys, for example in the Schedule for the Field Investigation of Volcanic Necks (pages 24–25), such complex phenomena as hardness are plotted under the heading of that category which is most specific to its nature. That is, in the case of hardness, the category *cat.* $I+c$, *To suffer a change in its properties*: because the degree of hardness of a given unit (mineral, rock, etc.) can be recognized only from a change (scratch, indentation, etc.) suffered by the unit tested.

Other phenomena of complex character are plotted under the headings of the different categories connected by them. This is particularly the case when a certain mode of being (for example, *To have colour*, *cat.* $III+a$) is to be represented in its dependence upon the C-H-L-P–conditions, or upon space and time. The colour of the eruptive rock in dependence upon the World of Light (sunshine or shade) is therefore plotted twice in the schedule, under *cat.* $III+a$ and under L as well. Colour in dependence upon the World of Humidity (in wet or dry state) is therefore plotted under *cat.* $III+a$ and under H as well.

In order not to complicate the picture of the schedule mentioned above, the 'complex' characters plotted in it are not specially marked or connected by lines, etc. The reader will find a number of such complex characters when carefully studying the schedule, particularly in those parts representing the C-H-L-P–conditions and the space-time relations (General Categories of Existential Being). In an actual field investigation of a geological unit, particular attention should be given to the observation of such complex characters or to the interdependence of the different characters of the unit studied. The relations found should be visibly marked in the forms used by (coloured) lines or other conventional symbols.

The problems discussed and the examples illustrated by the *Schedule for the Field Investigation of a Volcanic Neck or Neck Formation* may be sufficient to show the way of dealing systematically with the problem of the 'relations of different characters of natural units'; particularly, the way to a quantitative treatment of the problem so urgently stressed by the American authors appears to be open.

3. The Tetraktys as a Basis for the Process of Mineral Determination

Mathematical treatment of the problems of combination connected with the Tetraktys is not only essential for the application of this system to the construction and use of schedules for geological field investigations, but it appears useful also for the elucidation of certain fundamental problems connected with the process of mineral determination.

The results of the discussion of the *Natural* and *Near-Natural* working conditions made it probable that the Tetraktys may be applicable to the process of mineral determination. This was confirmed by an extensive critical investigation into the bulk of the literature on mineral determination. The works studied covered particularly the determination by means of the so-called external characters, the blowpipe, the ordinary and the polarizing microscope, and, as well, a number of other more specialized methods. Examples of the latter were methods based on spot tests, simple chemical reactions, or micro-chemical methods.

This literature consisted of books, tables, papers, reviews, and abstracts, totalling approximately two hundred titles covering the period from 1820 to the present. About sixty books and tables representing complete schemes and procedures for mineral determination were studied in the original texts and analyzed with regard to the categories and categorical terms of the Tetraktys. It was found that without exception the numerous different tests recommended in these books could be expressed in the categories and categorical terms of the Tetraktys. Furthermore, the order of sequence of the tests characterizing each of the many different procedures recommended in these books and tables could easily be represented or plotted in *Schedules for Mineral Determination* built up on the basis of the Tetraktys.

On the other hand, this critical review revealed the strange fact that apparently there does not exist a general theory for the process of mineral determination in the literature studied. Such a theory would have to supply a comprehensive answer to all of the following questions :

> Tests of what nature, in what number, in what combination or order of sequence, have to be used in order to determine *one* given mineral by discriminating it from a certain total number or group of known minerals ?

There is no doubt that this problem can be treated successfully by use of the Tetraktys, and by using calculations of the combinations possible between its categorical elements ; but the Tetraktys, as shown in the foregoing sections, is not restricted in its applications solely to mineralogy or to the geological sciences, and it may therefore be applied to the systematic determination of any natural units.

. . . to arrange its different characters in a certain order, and to connect it with an established systematic order of grouping natural things—

CLASSIFICATION

OBSERVATION

. . to draw the attention of the senses to it (i.e., the unit) and to perceive it through all senses possible—

DESCRIPTION

. . . . to call (give a name to) and to express it in words and sentences.

DETERMINATION

. . . to compare it with others, similar to it, and to discriminate it from them.

Figure 3

THOUGHT-SCHEME : INVESTIGATION OF A NATURAL UNIT

4. THOUGHT-SCHEME : INVESTIGATION OF A NATURAL UNIT—AS A GENERAL KEY TO THE APPLICATION OF THE TETRAKTYS

(*a*) *General Explanations*

Rather than including more examples and details of the application of the Tetraktys to the geological sciences, a general scheme may be given in the conclusion of this Paper to be considered as the general key to its different applications. This scheme is the *Thought-Scheme : Investigation of a Natural Unit* which is shown in Figure 3.

This scheme is called a *Thought-Scheme* as it represents nothing but a certain number of concepts in their characteristic co-ordination and order of sequence. Like other schemes presented in this paper, it has the form of a Tetrad, according to the

number of the main concepts combined and connected by it.

The thought-scheme shows, in the first place, the four constituent parts of any scientific investigation of a natural unit, inasmuch as this investigation tends to realize the highest degree of completeness. These four parts of a complete investigation are :

Observation
Determination
Classification
Description.

Any 'complete' scientific investigation, for example a monograph on a certain natural unit, should contain these four constituent parts. Conversely, the combination of these four constituent parts in order to form a higher unit completes what can be termed a full or complete investigation. The thought-scheme, by its arrangement with respect to the four constituent parts, symbolizes this mutual relationship between the elements mentioned. Definitions of each of these parts are given in the text of the scheme.

Furthermore, the broken lines shown in the scheme indicate the natural order of sequence in which these four parts of an investigation into a natural unit have to be treated. This order is : Observation → Determination → Classification → Description. The Tetraktys can be applied in its original form to each of these four parts of an investigation into a natural unit. The methods of plotting the data pertaining to the different parts cannot be fully explained in this Paper, but will be presented later in a more detailed description of the different practical applications of the Tetraktys.

Generally speaking, the thought-scheme can be used as a guide for attaining the highest degree of completeness of an investigation of a natural unit ; for example, a petrographical unit, an ore deposit, etc. It can likewise be used for checking the completeness of any prior investigation described in the literature. Thus the following four critical questions have to be answered, both during the course of an actual field investigation and during the study of a report on a previous investigation contained in the literature :

Observation : Did you observe *all* phenomena pertaining to it (i.e. the unit) ?

Determination : Did you make sure that it *is* that particular thing and nothing else ?

Classification : Where does it belong in our systematic knowledge of these things ?

Description : Is your report on the thing a complete one, or did you omit certain results from it ?

The completeness, or degree of completeness, of a detailed description of a natural unit given in the literature is checked by systematic comparison of all data contained in it with the corresponding categories and categorical concepts of the Tetraktys.

(*b*) *Examples of the Application of the Tetraktys to the Different Parts of an Investigation into a Natural Unit*

Application to 'Description'. The use of the Tetraktys as the most general and complete scheme for 'complete' descriptions of given natural units was first demonstrated in the address mentioned above (Koch, 1948). The American authors called their *Schedule for the Field Description of Sedimentary Rocks* (Goldman, 1922) 'a check-list for the field description of sedimentary rocks' applicable 'to any special case'. The Tetraktys, by detailed comparison with this schedule, proved to be the most general and complete check-system for such check-lists.

Application to 'Observation'. Twenhofel (1926), in the introductory notes to the modified reproduction of this schedule, points out that, in addition to its use for 'Description', the schedule can also be used directly for the observations to be made in the field. The Tetraktys proves particularly appropriate for this first and fundamental part of the investigation of a natural unit, because it systematically directs all senses, with their different functions, to the most complete observations of the units selected for the investigation. This is due to the fact that, according to its deduction and definition, the Tetraktys is based exclusively upon sense-perception.

Application to 'Determination'. The application of the Tetraktys to this part of an investigation has become obvious through the results already obtained from extensive studies into the literature on mineral determination (see also Postscript).

Application to 'Classification'. Examples of this type of application of the Tetraktys have not been given or discussed in this Paper. It may be remembered, however, that the deduction of the Tetraktys originated from a problem of the classification of minerals. Furthermore, as mentioned in Part II, the deduction and improvement of the definitions of the different categories of the Tetraktys were constantly checked against the principles already used for the natural classification of natural things. Consequently it can therefore be expected that the Tetraktys will be made the basis for future investigations into the principles of the *Natural Classification of Natural Things,* particularly in connexion with the problem of the natural classification of minerals and rocks.

The classification of rocks, particularly of the sedimentary rocks, on the basis of their lithological characters closely corresponding to the Natural Conditions, can immediately be expressed in the categorical terms of the Tetraktys. The classificatory systems or schemes themselves can easily be compared with each other after having been expressed in uniform categorical terms, as will be shown in a special publication. A general discussion of the problems of Natural Classification was given by Whewell (1837, 1840) in the chapters dealing with the *Classificatory Sciences*.

The process of *Naming* natural things (contained in the definition of 'Description', in the thought-scheme given above) has not been dealt with in this Paper. A process having the opposite 'direction' to the process of Naming, however, has been used in the empirical deduction of the Tetraktys as mentioned in Part II. The categories of the Tetraktys, i.e. the ultimate modes of being of natural units in the empirical reality of Nature, have been deduced from study of the meaning of the words used by the peoples of the world for 'naming' natural things. It is therefore expected that the Tetraktys, in turn, may be used in the systematic investigation of the principles of *rational nomenclature of natural things*.

In conclusion, the categories of the Tetraktys have been used in many instances for formulating the definitions presented and discussed in this Paper. This method of application of the Tetraktys coincides with Aristotle's doctrine (illustrated by numerous examples in his works) that a system of categories of a very elementary nature is the necessary basis of *any* scientific definition.

ACKNOWLEDGMENTS

The author wishes to take this opportunity to express his sincere thanks to Professor L. A. Cotton for his active interest and helpful suggestions during the progress and completion of this research; also to other members of the Department of Geology in the University of Sydney, in particular to Miss N. Hinder, B.Sc., and Mr. N. C. Stevens, B.Sc., for checking the manuscript.

The author also wishes to thank North Broken Hill Ltd., Melbourne, for their generous contribution, which has made possible the publication of this work.

The geological parts of this investigation were carried out under a grant from the Commonwealth Research Committee, administered by the University of Sydney.

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In view of the introductory character of the present Paper, no complete list can be given here of the considerable mass of literature referred to in the course of the investigations. The few statements made in connexion with the problems of mineral determination (pages 28–29) will provide some idea of the amount of work already carried out.

The following list of references, therefore, contains first of all those titles directly quoted in the present paper. The titles of some other works of a more general or fundamental character have been included in the list for the information of those who may be interested in the deeper roots of the concepts presented in this paper.

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POSTSCRIPT

After the completion of the manuscript of this Paper, the author delivered, on 19 November 1948, to the Geological Section of the Royal Society of New South Wales, an address entitled: *Use of the Tetraktys (or System of the Categories of Natural Science) in the Process of Mineral Determination.* A Summary of this address will be published in the *Proc. Roy. Soc. N.S.W.*, 1948 (in the press).

AUSTRALASIAN MEDICAL PUBLISHING CO. LTD.
SEAMER AND ARUNDEL STS., GLEBE, SYDNEY

The Australian Journal of Science

VOL. XI 21 April, 1949 No. 5

Science and Security

THOUGH knowledge is an individual acquisition, it does not properly merit description as human until it is shared. The devices of language and writing make possible the comparisons and assessments by which knowledge grows till it far exceeds individual range and is Man's knowledge in the wider sense. The advancement of human knowledge takes place in the composite mind. Free trade in ideas is the essence of the growth of human knowledge and is the life-blood of science; all that hinders that free traffic hinders the growth, and must be anathema to those who serve science.

Such statements seem simple platitudes, and it is banal to re-echo that science has conferred great benefits on mankind. These are so intimately part of the life of a modern community as to be accepted without question: the 'world' is content to marvel and receive the bounty; and as long as the applications of science contribute to comfort, welfare and enjoyment, science is a fairy godmother and all the reactions of a community to its kaleidoscopic activities are favourable.

The men of science are few: those who apply science and employ and exploit it for the community's ends and their own, and whose urge is not the pursuit of knowledge, are many. Groups of the many inevitably develop vested interests in the applications of science. The natural inclination of a person or group that by the application and exploitation of any knowledge gains an advantage, is to keep the process secret, not to communicate it. The basis of this inclination is the desire for security, whether of the person, of the community, or of its constituent groups. Security is thus the basic vested interest determining a possessive attitude to the retention of advantage. It is an attitude that is in sharp contrast to that of the man of science or other pioneer in the advancement of human knowledge. He knows that his effort is lost unless the knowledge is passed on and the sum of human understanding increased. That only is his true vested interest, and in the end it is mankind's.

The advances of science have been at times slow; but recently, in point of awkward fact, both scientific knowledge and its applications have increased at a rate that has put social adjustments out of gear, and particularly power adjustments.

The situation is not immediately in the control of the workers in the field of science. The results of their disinterested effort are intricately interwoven into the fabric of community life. Those who transfer and further evolve and adapt the techniques to apply the results to the community's needs and desires must have knowledge of science, and many who are truly men of science work in this field. Great ingenuity, skill and industry, and much education and instruction, are required to bring scientific knowledge into service; but the great bulk of those who make use of it have little need for intimate understanding of the magic they have at their command, and may have but little idea of the part it is playing in human affairs. A child can switch on an electric light and a schoolboy drive a motor car; the pilot who drops an atomic bomb need be neither a physicist nor a philosopher nor yet a politician.

The strength of a well-knit community lies in agreement based on the fullest understanding that can be attained in it. Those who wield power in a democratic community are its elected representatives. Theirs is the opportunity that goes with that power, and with them lies the corresponding responsibility to use with wisdom all means to make the community completely educated to use to the full the advantages knowledge can offer.

Power has many forms and may be used well or ill. Knowledge is power and as long as it is wisely and benevolently applied, all is well, whether that power is wielded through business, economics, military strength, religion

or politics. This is true also of scientific knowledge, though conditions make it but a pawn in the conflict of many different forms of power in the community. The increased power which science has given Man over his environment has inevitably, in the very process of its development, created new groups or interests, has strengthened some and displaced others, and has altered the distribution of wealth and, with it, the focus of incentive and the distribution of power. The balance of communities has been upset and gross adjustments are continually necessary. These adjustments have not always been painless or without major disturbances in the body politic.

There need be no surprise if the resulting imbalance should continue to have less peaceable results than the benevolent view of scientific activity might lead us to expect. The growth of knowledge not only increases power but intensifies the sense of power and the lure of exercising it. Thus the scale of modern wealth (mainly a gift of science) has magnified the portent of economics, and economic manipulation in unskilled or unscrupulous hands has proved dangerous to human welfare; yet more portentous and dangerous is manipulation in politics. The solution of the problem of the wise exercise of these powers has not yet appeared.

Science has performed the, by definition, impossible feat of splitting the unsplittable, and in so doing has succeeded in releasing illimitable energy. The most striking early manifestation of this scientific triumph has been, unfortunately, not the provision of a fuller life for everybody but the bursting upon the world of a new weapon of destruction.

For the moment at least the benevolent rôle of science is in the background; whatever blessings may yet accrue from harnessing this energy, science like economics has become manifestly dangerous. The balance and the basis of military power have been upset, giving rise to a new and bewildering set of speculations, calculations and readjustments. To universal mistrust has been added fear; and fear, the most dangerous of emotions to be let loose in the community, becomes a dominating factor in international relations. Reactions under its influence are liable to be irrational and violent. Repression, inhibition and retrogression are amongst its natural offspring.

Suddenly it is discovered that freedom of communication on scientific matters is in conflict with considerations of national safety. Communication of scientific knowledge in certain circumstances becomes treason. In the name of national security, a nation's governing group decides that means must be taken to control and direct the man of science and those who have access to his deadly secrets. Means must be taken to control what men shall know, who shall know it, who shall control those who know, and how they shall be controlled. Human knowledge, in particular scientific knowledge, has become once more a dangerous thing. It is not a far step to the suppression of magic and sacrifice of the magicians.

It is of interest that Bertrand Russell in a recent broadcast expressed the view that it would not be surprising if a powerful anti-scientific movement were to arise, as a result of the dangers to human life presented by the atomic bomb and the possibilities of bacteriological warfare:

> 'But whatever people may feel about these horrors, they dare not turn against men of science so long as war is at all probable, because if one side were equipped with scientists, and the other were not, the scientific side most certainly would win.'

There is certainly no argument in this for taking any action likely to diminish the tempo of scientific effort.

When knowledge because of its power is held to be dangerous, and is suppressed, or becomes secret and no longer communicated, the development of ideas, at the rate of which the human mind is capable, is hindered. Access to knowledge is forbidden because of fear, and a brake is put on the progress of man's mind and on scientific endeavour. It is not a new phenomenon in human history, and socially the situation presented is necessarily complex, but it is a situation which a civilized community should command enough intelligence to deal with in less primitive and barbaric fashion.

The newspapers have made us familiar with the sequence abroad of innuendo, suspicion, betrayals and purges—things that could not of course happen in Australia. Nevertheless, it is alarming that during last year a strangely violent dispute arose in the Australian Federal Parliament and a most unfortunate attack was made upon the Council for Scientific and

Industrial Research. The ordinary citizen is in no position to question the advisability or necessity of carrying out certain work on aeronautics in the Department of Defence. Data on which to make unbiased judgement in the dispute did not, perhaps could not, emerge from newspaper reports. Consequently no attempt can be made to assess in any way what considerations, departmental, national, or international, may have been involved in that decision.

Few if any would deny that, in the national interest, certain precautions and even the segregation of certain activities can be justified by circumstances, though it is proper to point out that, even then, liaison and communication must be secured if effectiveness of effort is not to be lost and defence itself not to be placed in corresponding jeopardy.

It is, however, a matter of serious concern that the attack was followed up by the precipitate passage of an Act of Parliament, taking power to transfer any or all of the activities of the Council for Scientific and Industrial Research to the control of Government departments, and the bringing of all appointments under the provisions of the Public Service Board.

The Council for Scientific and Industrial Research was founded upon ideas put forward by the Australian National Research Council, with the object of securing a degree of freedom from departmental control deemed essential to the development of the national scientific effort.

The transfer without residue of a section of the Council for Scientific and Industrial Research to the Department of Defence means, by so much, a loss of this very freedom which the remarkable success of the work of the Council for Scientific and Industrial Research has so fully justified. But the further assumption of power to bring the whole of the scientific effort represented by the Council for Scientific and Industrial Research under conditions of departmental dictation and restriction, goes far beyond the mere question of the propriety of the transfer of a small section of its activities to the Department of Defence. It is a step of the profoundest gravity and importance to Australia and Australian science.

Assurances that there is no intention to use the power thus taken for the transfer of any other sections, are worthless—leaves in the wind of political expediency. The Act was passed despite the strongest possible protest by the Australian National Research Council to the Prime Minister and the Minister for Defence.

It is not the officers of the Council of Scientific and Industrial Research only who are disquieted by this revelation of official attitude to scientific workers. The whole structure and pattern of scientific development in Australia will be threatened if such action is taken. Consequently the confidence of all directly concerned with that development has received a staggering blow. Positiv action will be necessary to restore it. This is an issue which should not be treated as of sectional interest nor on a party basis; it is a matter of national urgency. The Australian National Research Council, at the request of the Minister for Defence, has given detailed reasons for its lack of confidence in the Public Service departmental pattern of control as applied to science workers. It has given its considered opinion that the transfer of further divisions of the Council for Scientific and Industrial Research to the Public Service Board system would be the greatest disservice that could be done to the welfare of science in Australia. While this power is not taken in the Act passed in March 1949, it still remains in the Act of December 1948, under which Divisions or other Sections can be transferred to Government Departments by order of the Governor in Council.

The Australian National Research Council is not alone in its opinion on such control. Under this policy the best men will not be attracted to the service and some may leave it. Australia will in that case part with the substance for the shadow. The lesson is writ large in the experience of other countries, and it is one which Australia must heed, or yield place in a world which needs all the help that science can bring and in which even survival is likely in large measure to depend on comparative scientific competence.

Freedom of the C.S.I.R.

In its concern at the steps which were being taken in relation to the Council for Scientific and Industrial Research, the Australian National Research Council approached the Prime Minister in October 1948. Following a reply from the Prime Minister, Professor E. S. Hills and Professor S. Wadham visited Can-

berra on 24 November 1948 to place the views of the Australian National Research Council before the Minister for Post-War Reconstruction, the Hon. J. J. Dedman. At his invitation the Australian National Research Council prepared a considered statement (as mentioned in the preceding article) upon the ways in which the Council for Scientific and Industrial Research, or any of its constituent sections, would be disadvantaged if they were transferred to the control of Government departments and the Public Service Board system. This statement was conveyed to the Minister in a letter which is reproduced below:

6 December 1948.

The Hon. J. J. Dedman, M.H.R.,
Minister for Post-War Reconstruction,
Canberra, A.C.T.
Dear Mr. Dedman,

You will remember that, following on a letter from the Prime Minister, Professors Hills and Wadham, representing the Australian National Research Council, had an interview with you at Canberra on 24 November. They have informed us of the courteous reception which they received, and of your request for a considered statement on the ways in which C.S.I.R. or any of its constituent sections would be disadvantaged if they were transferred to the control of government departments and the Public Service Board system.

Before proceeding to set out our reasons for this conviction we draw your attention to the fact that this belief is firmly held by a large majority of scientists in Australia, and it is our opinion that C.S.I.R. under Public Service control will not only have difficulty in recruiting young scientists, but will actually lose some of its best members as soon as suitable opportunities arise either here or overseas. The same view has also been expressed by parliamentarians in the Third Report of the Parliamentary Select Committee on the Estimates, presented to the Parliament of the United Kingdom (1946-47), in the following terms:

> 'Your Committee are disturbed by the impression they have gained that the conditions of government service do not always create an atmosphere attractive to research workers or conducive to the achievement of scientific progress. This is not a matter of adjusting salaries and grades. Certain cherished freedoms are lost. Departmental control tends to have a deadening effect. Administrative routine, though an essential part of the machine, sometimes gives the impression of being devised for no better reason than to harass and put a drag upon advances. Many young scientists were temporarily employed in departments during the war. Some have stayed, attracted by administrative work; others have left with a sigh of relief.'

The reasons and arguments set out below are presented quite frankly. They represent our considered opinions, which we base on long acquaintance with conditions in the Public Services of the Commonwealth and States of Australia, in Great Britain and in U.S.A., as well as on our knowledge of organizations under other forms of administration. Departmental and Public Service Board control of the Council for Scientific and Industrial Research is likely to be disastrous in ways which can be grouped under the following three headings:

(a) *The conditions affecting staffing and establishment*

1. A variety of forms of organization is required for scientific projects, most of them being different from the normal administrative 'pyramid' of the Public Service form. It is often the case that most of the officers concerned will be relatively senior, with only a few juniors.

2. If an investigation develops favourably, there must be provision for rapid expansion of the establishment and immediate increase in status of existing staff. The transfer of persons in order to change their status, or the advertisement of the position at higher status, is entirely unsuitable in most instances, since only those connected intimately with a particular branch of science are capable of handling the work in that branch.

3. The 'appeal' system is particularly undesirable for scientists, most of whom would freely admit that seniority does not of itself constitute valid grounds for discrimination as to professional status.

4. In scientific work senior officers alone are not responsible for the flow of ideas. Constructive thought and criticisms from subordinates are essential to success, and maximum freedom must be permitted them. Under Public Service administration these conditions can scarcely be said to be the rule.

(b) *The probable effects on scientific work itself*

1. Clearly, government policy must strongly influence the kind of investigations carried out and the magnitude of the effort to be made; but for the organization and conduct of the work it is essential that scientists, who alone fully understand the problems involved, should be free to exercise their own judgment, within the general limits dictated by policy.

2. The interposition in the organization of administrative non-technical officers leads, in our experience, to frustration and even to impotence. This is particularly true when immediate practical results are asked for as a justification for scientific work, instead of permitting a long term view to be taken in relation to the development of a research programme.

3. Again, the achievement of a result which is solely practical in character is no justification for terminating a research unless the scientific basis for that result has been fully investigated. The following instance illustrates the point. It was shown overseas that animals failed in health on one particular

class of country, and that this could be overcome by grinding up a mineral and feeding it to them. In Australia it was *deemed* essential that the matter should be taken further and the active principle in the mineral determined. Further research demonstrated that cobalt was the element concerned. Thus a wide field of new knowledge resulting in immense gain to primary producers was opened. The first stage was discovered by a government research organization which ceased work at the 'practical' stage. The investigation was carried out in this country by a department which had wider scope.

Historically, Archimedes solved a difficult scientific problem while in his bath. This is not an argument for shower rooms in scientific laboratories; but it reminds us that those whose work is creative—as that of most scientists undoubtedly is—may produce results under conditions very different from the routine administrative schedule. Their desire is to succeed in producing results, but success cannot be *demanded* of them. The aim should be to place them in an atmosphere most conducive to success, and experience shows that if this is done success will come, given the necessary powers of intellect.

(c) *Dangers of interference in policy and direction at high level*

1. The problem of ministerial control of a technical department carrying out research, some of which may be useful to the community, is much more complex than at first appears.

2. Political theory suggests that Parliament should control all activities financed by public funds. In the case of most departments such control is exercised through the medium of a Cabinet Minister.

3. The simpler the activity of a department, and the more numerous its contacts with the general public, the more necessary does this arrangement become. Without it, the public would have little or no redress against inefficiency or unsatisfactory behaviour in the staff of posts, police, customs, or other governmental services. Conversely, where the activity is more complex, ministerial control becomes much more difficult because most ministers will find it difficult to understand the real significance of policies and methods of operation of the organization.

4. The Council for Scientific and Industrial Research is the extreme case where, in some activities, ultra-specialists are investigating problems, the inner significances of many of which require extremely specialized knowledge. Naturally it would be rare for a minister to be able to appreciate the niceties of many research techniques essential to sound scientific progress.

5. Ministers come and go, and some have more wisdom than others. Observation suggests that, to some, the sensation of power is very attractive. The larger the departments they control, the greater the sense of power and also the greater their opportunities of being able to do things which seem large and important to the public or sections thereof.

6. We write very frankly because we believe this matter is really important. In so doing we run the risk of appearing discourteous to you personally, but we assure you that no such discourtesy is intended, and we are quite well aware both of the number of unpleasant tasks which fell to your lot during the war (e.g., the inauguration of rationing) and also of the fact that you have given no grounds for criticism of the type mentioned.

7. Our reason for stressing the points is that we have unfortunately had reason to observe so many instances in public departments where scientific work has been disorganized and rendered nugatory by ministerial interference.

8. It seems clear to us that the relative independence of the Council for Scientific and Industrial Research from departmental control is a matter of strength, which should be used by a minister as a bulwark against outside pressures, and therefore it should be continued.

9. On the other hand the Minister and the public do need some protection against possible extravagance or inefficiency. At present the Minister has control of the financial grant to the Council for Scientific and Industrial Research and himself appoints an independent Council of men of high integrity and great experience to advise him. Further protection could be achieved in various ways which would be preferable to those envisaged in the present Bill. For example, changes might be made in relationships of the Council to the Executive. Or again, if necessary, the Minister could arrange for periodic inspection of the Council for Scientific and Industrial Research laboratories by appropriate specialists of high standing. Such men might well be appointed from overseas.

We believe that direct ministerial control of the Council for Scientific and Industrial Research *in the form of a department of the Public Service* could be disastrous, and we suggest that the mechanism of review and independent criticism outlined above would safeguard both the Minister and the public.

That the arguments set out are not without foundation in experience is patent to unbiased observers of the fate of most scientific Public Service organizations. We realize that in the most favourable conditions, especially with expansion in a department connected with rapid developments in the community—conditions which exist in Australia today—the full restrictive effects of Public Service administrative forms may not be felt. We realize also that in all such large questions of government policy it is the overall picture that must be considered, but to us it seems imperative that Australia should be given the most effective organization for its scientific effort. For the reasons we have set out we should regard the transference of the Council for Scientific and Industrial Research work (except possibly sections specially significant to defence) to

departmental or Public Service Board control as the greatest disservice which any government could render to scientific effort in this country.

May we assure you, in conclusion, that we should be only too willing to discuss further the matters raised in this letter if you should so desire.

For the Executive Committee of the Australian National Research Council,
Yours faithfully,
A. W. TURNER,
Acting Chairman.

A.A.S.W. Comment

In mid-1948 the Victorian Branch of the Australian Association of Scientific Workers had expressed its belief that 'Australia can hardly hope to escape the world-wide tendency towards integration of scientific research with military programmes unless scientific workers make their voice heard now; otherwise they are likely to be faced with a *fait accompli* made without adequate consultation with scientists, which would be extremely difficult to change'. This organization made a declaration of policy, in March 1948, which included the following:

The Association will not oppose any research or development work necessary for the defence of Australia, and such security and secrecy measures as are necessary to safeguard such work. At the same time it insists that the free interchange among scientists of scientific information is vital to scientific progress and that restrictions imposed from motives which have no real connexion with defence must be opposed vigorously. It is alive to the dangers inherent in a situation in which a whole laboratory may be placed under secrecy regulations merely because some portion of its effort is associated with the defence programme . . . Restrictions on an international scale, especially when certain countries pool resources while excluding other countries, merely intensify international suspicion, increase the danger of war, and are of little value unless immediate war is expected, since most 'secret' discoveries follow in the course of normal scientific development in any country . . .

Government policy on the extent of secret scientific research for defence should be guided by the advice of qualified scientists. The devotion of an unduly large proportion of Australia's resources of materials and scientific manpower to purely defence purposes is not in the interests of science or of the community; nor, in a long range view, of the best defence of Australia . . . A considerable increase in fundamental research is necessary to enable science to progress independently of military needs and to improve the living standards of the Australian people and the industrial potential of the country—thereby contributing both to the national welfare and to national defence . . . Australian scientists should not wait for the development of an unfavourable situation that may be difficult to rectify. They should combat all tendencies to limit scientific investigation and to suppress scientific discoveries. They should seek to influence the Australian Government to pursue a liberal policy towards science in Australia.

Other Organizations

During 1948 the position which appeared to be developing with regard to the Council for Scientific and Industrial Research caused discussion in most scientific associations within Australia, and in some outside of Australia. The Council of the Royal Society of New South Wales, for example, held a special meeting on 18 October 1948, to discuss 'The Freedom of Science'. Although the meeting considered that it did not have positive evidence that freedom of science was an issue in Australian science at that time, it decided to record its views in the following minute:

(a) Progress in science can be effective only when fundamental results are pooled; secrecy in fundamental science must have the effect of retarding progress. In general, secrets related to defence are matters of technological appliance rather than fundamental results of pure science.

(b) A worker who signs a contract of secrecy, whether with a private firm or a government, is bound to fulfil his contractual obligation. This will almost always be in the field of applied science.

Members of the Council were of the opinion that applications to defence could be dealt with by a body separate from the Council for Scientific and Industrial Research, without in any way interfering with the nature and scope of the fundamental research which that body has so effectively undertaken and which is so intimately bound up with its work in applied science.

As an example of the concern of applied science, one may quote from a leading article published under the title 'What Will Happen to C.S.I.R.?' in the *Chemical Engineering and Mining Review* (*41*, 41, 10 November 1948):

> Powers and functions of the Council are defined by the 'Science and Industry Research Act, 1920-1945', and include the initiation and carrying out of research in connexion with primary and secondary industries, the making of grants in aid of pure research, and the establishment of an information service relating to scientific and technical matters. Finance is provided by the Commonwealth Government and by numerous contributions from organizations and trust funds. Activities of the Council, which consists largely of scientists nominated by the Commonwealth Government, have necessitated a widespread and flexible organization. Undesirable centralization has been avoided . . .
>
> The new Bill provides that any work being performed by the Council for Scientific and Industrial Research may be transferred to any Commonwealth department at any time, simply by proclamation. . . . Why is the Bill not confined rigidly to defence research? Is it that transfer of other kinds of work is contemplated, or that the threat of transfer is to be used as a means of exercising political control over the decisions of the Council? If the aim is to bring all research eventually under departmental

> control, then the mining industry will protest strongly. The present system has worked well for twenty-two years. Carefully planned long-term research is possible without interruptions due to local departmental policies or temporary expediency. A change to 'departmental' research would probably result in the drying up of voluntary financial aid from many organizations, and is likely to weaken or break the present cordial links between research and industry. A company may well hesitate to confide in a research body that may be obliged to pass the information on to others.

When the Bill of December 1948 came before Parliament, the Council for Scientific and Industrial Research itself issued a statement expressing its grave concern, that the Bill—

> 'empowers the Government to transfer any part of the work of the Council, irrespective of its connexion with defence, to the control of various Government departments under the Public Service Board. The Council was not consulted before this measure was introduced and has only now been permitted to meet to discuss it. No adequate reasons for the wide powers incorporated in the Bill have been advanced. If the Government were concerned only with defence research, much more limited powers would suffice. The Council fully agrees with the Government's decision that defence research should be carried out in specially organized laboratories, and welcomes the formation of an organization for this purpose within the Departments of Defence and of Supply and Development. C.S.I.R. is agreeable to transfer to the new organization activities definitely of a defence nature, leaving it free to fulfil its wide statutory responsibilities of carrying out research for the benefit of primary and secondary industries. It has offered the defence authorities all the assistance in its power in building up the defence scientific effort. . . . In a national emergency, the Council would throw the whole of its effort into defence research, as during the recent war: any steps necessary for security will have the Council's entire co-operation. The Council urges the Government to amend the Bill, so that the Bill's operation is restricted to research connected with defence.'

Overseas

Many scientists in different parts of the world believe that secrecy, in itself, breeds wars; whether it is secrecy in applied or fundamental research, or in other matters of national policy. Even from the viewpoint of nationalism, however, it seems that our capital of fundamental research has been so exhausted during the recent war that we cannot be strong again until it is restored; and it cannot be restored unless science resumes its natural free habitat. The following extract is taken from the Presidential Address to the Dundee Meeting of the British Association for the Advancement of Science, August 1947 (*The Advancement of Science*, **4**, 151):

> I am not, of course, thinking just now of the perversion of science which war research involves through its particular business with the means of slaughter and destruction. For the moment I am concerned with the fact that the response to war's demands has led the majority of scientists of this country to devote nearly the whole of their thoughts and efforts, during six years or more, to practical problems presented to them for rapid solution. There must, indeed, be many younger men who have had little experience of other kinds of research than that which has been thus directed, and even restricted, to near and practical objectives and carried out under a pressure of urgency. From Government organizations and industry, awakened by war's experience to a fuller awareness of what science can do for them under such conditions, it is not likely that encouragement will be lacking for a continuation of similar activities into peace. . . .
>
> Does anyone doubt that, to enable science now to render its best service to mankind, we need to take a long-range view and to give our first care to the extension of fundamental knowledge, unconstrained by aim at any practical objective? I am not concerned to advocate, or to defend, a philosophy postulating the advancement of our knowledge on the one hand, or the material betterment of man's lot in the world on the other, as the ultimate motive of scientific effort. I believe that it would be admitted, by partisans of either doctrine, that research which seeks only to advance pure knowledge commonly leads in the end to the widest practical developments; and that examples are plentiful of practical researches, conducted under conditions which leave full freedom to follow side issues, opening the way to great fundamental advances. The concentration, however, of practically the whole of a rapidly growing scientific effort on practical applications and developments, such as the war has witnessed, might find instructive analogy in a rapid extension by a commercial undertaking of its trading enterprise, without care to conserve and to expand its working capital; or in a reckless cropping of land, without care to nourish the soil. . . .
>
> I believe that, under conditions now to be faced, the building up of our scientific capital of fundamental knowledge by those who have the creative gift, should have a prior claim over its practical exploitation and over any cultivation of its political influence . . .
>
> Science, then, finds itself facing a situation in which hope and frustration contend; the need to make the world safe, and the delay in agreement on the means of doing so, clog wheels of science which should even now be turning freely for the enrichment of knowledge and human life. How then are we men of science to deal with such a situation? With unquestioning loyalty to all our obligations—that first and foremost; but then also, I would urge, with a resolute watchfulness against any encroachment, on activities proper to peace, of a secrecy which we accepted as an abnormal condition in war, and with a determined effort to accelerate the liberation of science from all such entanglements. . . .

Of conditions which have developed in the United States of America during the post-war years, it may be sufficient to quote extracts from two statements. The Federation of American Scientists reports with regard to the Atomic Energy Commission:

> Loyal scientists, lacking knowledge of the criteria for clearance or lacking confidence in fair dealing, have desired to leave the laboratories of the Commission and others have hesitated to enter the service of the Commission. The atmosphere of fear and uncertainty engendered by the occasional unfounded clearance charges may cause

many scientists to withdraw entirely from any type of civic responsibility.

The Federation of American Scientists has established a *Scientists' Committee on Loyalty Problems*, to provide information and legal advice to individual scientists faced with clearance problems. It is stated that through study of clearance procedures and criteria for judging loyalty the Committee hopes to contribute toward establishment of a sound national policy. The Committee will seek to obtain full and fair hearings by government agencies and Congressional committees, as well as fair treatment in the Press.

The head of the National Bureau of Standards states with regard to his own Bureau:

> There have been mounting tension of threat of purges, spy-ring exposures, publicity attacks and sudden dismissals without hearings. All of these make scientists increasingly reluctant to work for the Government. They greatly unsettle their minds and distract them from creative efforts . . .
>
> Germany, Italy and Japan greatly weakened their scientific condition by a general intimidation and a stifling of free enquiry. It has been said that after every war the victors adopt the vices of the vanquished. I am sincerely concerned that we are on the point of doing that. The whole scientific life of the nation is involved. (Letter published in the *Bulletin of Atomic Scientists*, April 1948.)

The C.S.I.R.O.

On 8 March 1949 the Minister for Post-War Reconstruction introduced a Bill to the Federal Parliament to reconstitute the Council for Scientific and Industrial Research, changing the name to the Commonwealth Scientific and Industrial Research Organization. The Government assumes full responsibility for the Organization, through a chief executive officer who acts as chairman of an executive council of five (including the chairman), three of whom are scientists. The executive is to be responsible for initiating research and investigations and will recommend to the Government as to funds required; it will be appointed by the Governor-General on the advice of the Minister. There will also be an advisory council, constituted similarly to the former C.S.I.R. and appointed by the Minister, which is to advise the executive council on the general work of the Organization and on specific projects.

Present employees of the C.S.I.R. are to pass a 'character test' and take the oath of allegiance, on transfer to C.S.I.R.O. control, and new employees are to be similarly screened. Such screening is to be conducted on lines already practised by the Public Service Board. The general effect of the administrative changes is to bring the C.S.I.R.O. under the general supervision of the Public Service Board, especially as regards conditions of staff employment and rates of pay. In keeping with the representations made by the Australian National Research Council, as quoted above, the scientific portion of the staff (while scrutinized by the Board as regards character, conditions and salaries) is to be employed by the Minister, not through the Public Service Board. There is some satisfaction among scientists as to these provisions. Although the Act of December 1948 still retains the provisions that are alarming to many scientific workers, the new Bill does something to relieve the general apprehension. The Bill passed through all stages, without amendment, on 16 March 1949.

National Security

A. D. THOMAS*

MURMURINGS of controversy on the question of freedom in science could be heard in the later years of the war. The problem was emphasized, more than it might have been, by the extraordinary restrictions placed on publication relating to applications of nuclear energy; but restrictions were also applied during the war in other fields, such as electronics, chemistry and engineering. On the one hand, protests against restriction on the dissemination of scientific information have been made by individuals and by scientific organizations, whilst the contrary view has been expressed largely by a succession of Acts and Regulations of Parliaments and Governments.

It is generally agreed by all that secrecy is a serious obstacle to the advancement of scientific thought. Complete freedom is the goal towards which we should direct our efforts. The case for freedom has been put by numerous leaders of science. There are, however, other considerations; it is incumbent upon us, as scientists, to view the question objectively, studying the reasons behind the restrictive regulations.

Secrecy in science takes three main forms:

(a) Secrecy temporarily imposed by the scientist himself during the progress of a piece of work, for personal reasons.

(b) Trade secrecy imposed by an employing organization, to conserve advantages over rival commercial organizations; a restriction which is irksome to many research workers, but not a major threat to the overall freedom of scientific intercourse.

(c) National defence secrecy, which appeared during the 1914-18 war, reached a peak during the 1939-45 war, and is likely to remain in a modified form in our peace organization.

To understand the background of defence secrecy imposed upon science, we must step from the field of science into the political and international arena. The present world situa-

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tion indicates that international order, backed by a world police force, is far distant. It is therefore essential, owing to this impotency of international organization and the hostile attitude of certain nations, that we take steps for security on our own part. When potential aggressor nations, more powerful than ourselves, agree to collaborate for peaceful ends, we shall be glad to play our part in ushering in the new era. Until then—for the sake of the ideals for which we have recently fought and for the safety of our people—we must maintain armed forces and their complementary units. The purposes (cumulative or alternative) for which nations support such forces are:

(a) for internal policing duties;
(b) to support a world police force under an organization of united nations;
(c) as a war machine designed (consciously or unconsciously) for aggressive military action;
(d) as a safeguard against aggression feared from another nation.

For all of these, except the first, the armed forces are maintained for use *as extensional instruments of the nation's foreign policy.* In the British Commonwealth, free of uneasy totalitarianism, armed forces are wanted as internal police only to a negligible extent. We are not at present committed to providing armed forces to serve the United Nations, and there is no real hope of peace being secured through such a medium during the present generation. Aggressive war is unthinkable in the modern enlightened British democracies. Our armed forces are therefore required only for the fourth purpose stated—defence against a risk of aggression which is considered sufficiently real. The world is now as unsettled and hostile as it was in the years immediately preceding 1940. *The likelihood of another world war in the next fifteen years or so constitutes a relatively high probability.* Let there be no mistake about the gravity of the situation. There are powerful forces elsewhere which seek to impose upon the whole world a way of life in which *complete secrecy* would be the order of the day.

> 'Australia has been taking positive steps towards international disarmament in relation to weapons of mass destruction, by actively supporting an international control or policing system. At the same time, after bitter experience in two world wars, the Australian Government has a supreme duty to our people to maintain the vital defences of Australia. To abandon defence projects immediately would be to invite disaster . . . We must never sink back into the state of unpreparedness which characterized so many of the democracies in 1939, when Hitler struck.' (Evatt, 1947, page 8).

It is now generally recognized that in modern warfare the triumvirate,

(a) science,
(b) air power,
(c) industry,

reigns supreme. Land and sea forces are still of importance, but the first line of offence and defence is in the air. Armed forces, however, on land or sea or in the air, are relatively impotent unless built upon scientific research and industrial development. It takes years to build up the necessary scientific, industrial and military 'capital' on which a nation must 'live' during war. The maintenance of adequate safeguards for security is thus a matter which concerns all people of the Commonwealth; national defence is not a matter purely for the armed forces. The ideals expressed in the phrases 'Culture is international', 'Science is international', are being misused today as political propaganda on behalf of a foreign power. It is ostrich-like to remain aloof from the international problems confronting one's own country. For a scientist to hold the view that national defence is purely a matter for the military body is beyond comprehension.

It is not intended here to claim that restrictions should be placed on scientific publication beyond such as are essential to national security. The restrictions should be the subject of continual review. On the other hand, all scientific research not under secrecy should be regularly reviewed by competent men to see what aspects should, in the nation's interest, be transferred to the 'secret' category. The universities should essentially be the centres of free fundamental research. The greater part of the scientific work performed in other institutions is also publishable, from the security viewpoint. Even those with little or no scientific training now realize that our scientific capital was heavily mortgaged during the war, so that it behoves us to press on with the re-establishment of that free atmosphere in which scientific research flourishes and in which research scientists are nurtured.

The defence authorities of Australia are most anxious to see the rejuvenation of scientific research of all kinds—free and fundamental research and applied research—the degree of freedom being governed by the requirements of national defence.

The Service man today is not a man who likes war or desires war. Some may like the collective way of life, or may love the sea, or may love flying, but they are not a group of war enthusiasts. Similarly, the Service man finds the security restrictions to which he is subjected a burden—but a necessary one in the circumstances: they reduce his field of intercourse with his fellow men; they deprive him in varying degrees of one of the four freedoms. Why then does he accept an occupation which, in the ultimate analysis, is restrictive and distasteful? The answer is simple: He believes that Australia is in peril of attack by an aggressive foreign power—not necessarily today, but during the next decade or two. If the aggression were to succeed, a discussion such as this, on 'Secrecy and

Science', would be prohibited. The question is not one of 'All or Nothing': it is a matter of accepting a limited number of restrictions for the sake of safeguarding the enormously larger part of our liberties.

In several fields of science today, a situation exists similar to that of the development of radiolocation of aircraft prior to 1939. At a time when British, American and German scientists were working independently on the problem, the Battle for Britain was won only because Britain, whose scientists had progressed much further than their competitors, had successfully carried through a policy of complete secrecy as to radiolocation. There are some who suggest that secrecy regarding our scientific developments is a prime factor adversely affecting international relationships; and the argument is addressed, directly or indirectly, to our military authorities. Military planning and policy, however, are primarily dependent upon international policies and relations. The case against secrecy should be addressed to the political leaders of aggressor nations. Were they to lift the restrictions current in their countries, then we could gladly remove such constraints as exist—*constraints which are the bare minimum necessary for national security and are negligible compared with those existing in some other countries.*

The following quotation (with italics added to the original text) from Lord Portal (1947), who was formerly Chief of the Air Staff, Royal Air Force, and is now Director of Atomic Energy in the United Kingdom, summarizes the situation:

> 'Like the discovery of flying, this atom business is in many ways very awkward. I sympathize very much with the scientific men. It is perfectly true that the prospects for the good uses of atomic energy which are already foreseen, and for the discovery of others not yet foreseen, are at present gravely affected by international distrust and the resulting need for secrecy and strict Government control of the whole business. Secrecy is in itself a brake on progress, and, if it has to be continued indefinitely, it may well drive some good men in disgust to other lines of research where freedom is allowed and can do no harm. Government control, though it is absolutely necessary under present conditions, and perhaps always will be, means that the best brains in industry, particularly on the engineering and metallurgical sides, which are every bit as important as the nuclear-physical side, are difficult to mobilize upon the problems of development.
>
> 'No one could recognize all this more clearly than we officials who have to help to administer the law, but *it really is no use pretending that conditions today are appropriate for the casting of all secrecy to the winds in the name of freedom of science.* What we can and will do is to try, consistently with our duty, to minimize the inconvenience caused by the restrictions and to interpret the will of Parliament in a liberal spirit.'

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The Wolf Creek Crater

FRANK REEVES* and R. O. CHALMERS.†

The Wolf Creek Crater is situated in the East Kimberley district of Western Australia, in longitude 127° 46′ E., latitude 19° 10′ S. It lies on the north-eastern margin of the Desert Basin, 370 miles inland from Broome and 64 miles south of Hall's Creek (the nearest large airfield). A rough car track leads south from Hall's Creek to Ruby Plains and Billiluna cattle stations and passes eleven miles west of the crater. To reach the crater, one may leave this track at Beaudesert well, continue down the west bank of Wolf Creek for twenty-three miles, then cross the creek and go about a mile and a half east. The crater is visible for some distance above the desert sand, appearing as a flat-topped hill.

The crater was observed from an aircraft in June 1947 by Frank Reeves, N. B. Sauve and Dudley Hart, during an aerial survey of the Desert Basin for the Vacuum Oil Company and its Associates. From the air it looked like a huge bomb crater and was thought to be of meteoritic origin. It was reached on the ground two months later, by Reeves, H. Evans and Hart, travelling by car from Billiluna Station.

The crater is approximately 150 feet deep and 2,800 feet in diameter at its bottom. The rim rock rises from 60 to 100 feet above the adjacent sandy desert. The walls are steep and are composed of hard micaceous sandstone, probably pre-Cambrian in age, which is shattered and tilted outward from the crater. The rim rock consists of sandstone talus, partly drifted over by windblown sand on its eastern side. Trees of considerable size grow in the bottom of the crater, around a clay-pan in which there are sink holes which expose calcareous tuff. No meteorite fragments were found in the vicinity, but only about two hours were spent there.

As a result of their preliminary observations, Reeves and Evans were inclined to believe that the crater was of explosive volcanic origin, because they did not think that a meteorite blast could tilt the strata so regularly. No volcanic material, however, was found in or adjacent to the crater.

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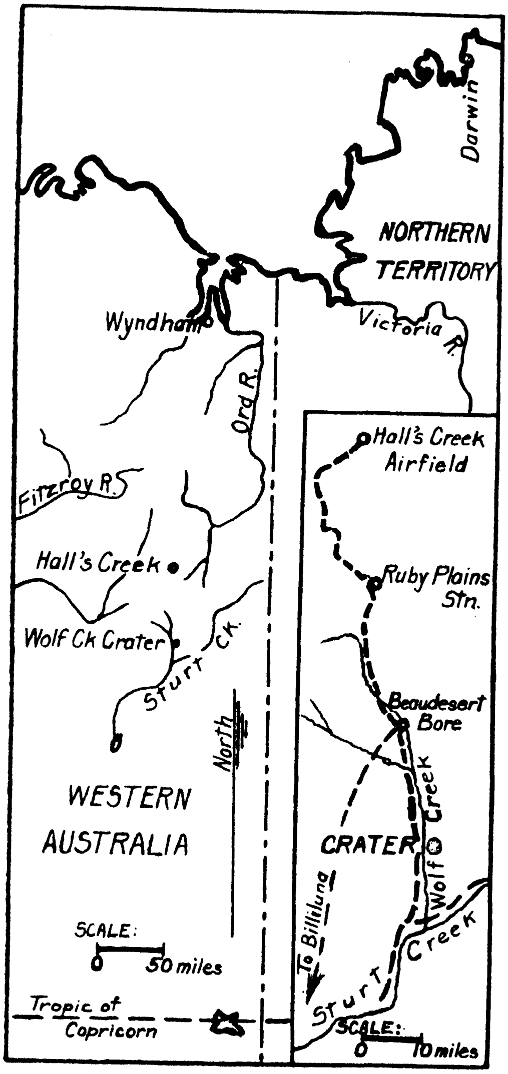
† R. O. Chalmers, Curator of Minerals, Australian Museum, Sydney.

Soon after noticing the crater from the air, Reeves reported it to Dr. H. G. Raggatt, the Director of the Commonwealth Bureau of Mineral Resources. Dr. Raggatt and his colleagues, upon seeing a photograph of the crater, were impressed with its resemblance to a photograph of the meteorite crater in Arizona



as shown in the *National Geographic Magazine* for June 1928. Reeves and Evans, upon seeing this photograph, were also inclined to reverse their opinion and concede that the crater was probably what it was first judged to be—a meteorite crater.

Geologists of the Vacuum Oil Company intended to visit the crater in 1948, but their explorations of the southern and central part of the immense Desert Basin gave them no opportunity. It was, however, visited by two other parties during 1948.

A party sent out by the Australian Geographic Society examined it in August and an article describing the crater was published in the Society's magazine, *Walkabout*, for November 1948 ('The Hidden Crater of Wolf Creek', by Charles H. Holmes). During the same month a geological party from the Commonwealth Bureau of Mineral Resources, headed by R. S. Matheson and D. J. Guppy, spent two days at the crater and discovered evidence of its meteoritic origin. The following is part of Matheson's report on the crater:

> During the course of the investigations ironstone fragments, which are probably of meteoritic origin, were discovered for the first time. These are abundant on the rim of the south-west sector, and elsewhere occur only as scattered fragments. These ironstone fragments are decomposed, rounded, and exhibit a 'breadcrust' structure, and their physical character appears to be similar to fragments of decomposed meteoritic iron obtained around the large meteorite crater in Arizona, U.S.A. The ironstone fragments are up to about six inches in diameter. Specimens of the ironstone fragments have been submitted to the West Australian Chemical Laboratories for analysis and confirmation of their meteoritic origin.
>
> The abundance of meteoritic ironstone around the rim in the south-west sector suggests that this is the out-throw side after explosion and that the meteorite prior to impact was travelling from north-north-east to south-south-west. Scattered quartzite boulders outside the rim rock on the south-west side also suggest that this is the out-throw side of the crater.

A specimen of the ironstone given to Reeves by D. J. Guppy was sent to R. O. Chalmers at the Australian Museum, who concludes that it is the weathered product of an iron meteorite. Chalmers's report on the specimen follows:

> A specimen of this material sent by Dr. Frank Reeves was examined. Superficially it appears to be what is commonly called 'ironstone'. It is dark reddish-brown, and a good deal of the specimen has a varnish-like lustre. Portion of the specimen is covered with a light reddish-brown earthy coating. In places thin veins of reddish hæmatite can be seen. The specimen is not homogeneous, because some portions show a typical red hæmatite streak and other portions show the yellowish-brown streak of limonite. An encrustation of unidentified pale yellowish-green mineral, no doubt containing nickel, was noted in two places. The specimen contains 1·9 per cent. of NiO. It is therefore an oxidation product of an iron meteorite. It is practically identical in appearance with the 'iron-shale' described from the Henbury meteorite craters in Central Australia (Alderman, 1928-32 and

1932). Such oxidation products of iron meteorites are also described from other localities, including the famous meteorite crater of Cañon Diablo in Arizona, U.S.A.

Such material is usually referred to in the literature as 'iron-shale' and is usually said to consist of limonite. The specific gravity of this specimen as a whole is 4·05, which indicates that it consists largely of limonite. The nickel content indicates that something else is present, and this is no doubt trevorite ($NiO.Fe_2O_3$), which is magnetic and would account for the fact that small fragments of the specimen are magnetic. (See Shannon, 1927.)

It would be interesting if unoxidized specimens of the meteorite were discovered, because a comparison between the original nickel content and that of the 'iron-shale' would indicate what leaching of nickel has taken place, and thus might throw some light on the age of the fall. Nininger (1938) showed that nickel is lost from meteorites in the course of weathering. This is also indicated by the fact that a trace of nickel appeared in the water in which the Wolf Creek specimen was boiled for determination of specific gravity.

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General Algebraic Methods in Mathematics and Physics*

H. SCHWERDTFEGER

NOTHING substantially new will be presented in this short paper. It is addressed mainly to the physicist: to the mathematician only in so far as he supplies the mathematical tools for the physicist. One may start with a personal observation which has been confirmed by several colleagues. When a lecture course on group theory or some other branch of modern algebra is arranged (occasionally following a suggestion from the physics department), we notice that the greater part of the audience consists of physics students who, evidently, hope to learn the secrets of quantum theory 'in the easy way'. Soon, however, they realize that study of group theory means hard work, apparently not along the geodesic to the summit of knowledge. Thus after a few lectures they leave the field to the pure mathematician, and only those remain who are willing to face the difficulties of higher algebra. Naturally these should not forget that, on the other hand, algebra alone is not sufficient for the understanding of the relevant physical facts. This statement is competently discussed from the point of view of the physicist in the booklet by M. BORN (1944), *Experiment and Theory in Physics*.

For us the following question arises: *What is then the use of algebra in the sciences and in what way does algebra contribute to the understanding of scientific theories?* Let us not dwell upon the obvious advantage of an elaborate mathematical algorithm which to a large extent is actually supplied by algebra and is often called 'the algebra' of a piece of work. We shall rather trace a few deeper ideas which the student of physics should try to realize before he embarks upon a study of modern algebra.

THE DEVELOPMENT OF ALGEBRA

Until about 120 years ago algebra (or rather the part of it which we call 'algebra' today) was concerned with the purely manipulative aspect of the so-called elementary operations, viz., addition, subtraction, multiplication, and division, and the root operation within the domain of the real and complex numbers. The dark problem of the root for any algebraic equation lurked in the background; but it led to no spectacular development as long as it was considered in its historical setting, requiring an explicit general formula for the roots of any algebraic equation of degree n, after the pattern of the well-known formulae for the quadratic and cubic equations. Long researches, lacking a leading principle, led to a corresponding result for any equation of degree four, but not further. Only the famous work of LAGRANGE (1770) gave the first systematic approach to the problem and explained

(a) why general ('literal') formulae could be obtained for $n = 2, 3, 4$;

(b) why for $n > 4$ essentially different conditions prevail which made it unlikely that a literal solution of the equation of nth degree could be found if $n > 4$.

A little later RUFFINI (1799) and ABEL (1826) proved this conjecture; not before GALOIS (1832), however, had discovered the *group of an algebraic equation*, could the result be really understood.

This discovery, decisive for the theory of algebraic equations, was at the same time the first step in the development of 'modern algebra'. In order to explain briefly, let

(1) $$x^n + a_1x^{n-1} + \ldots + a_{n-1}x + a_n = 0$$

be an algebraic equation with rational coefficients $a_1, \ldots, a_n$ and the n different roots $\alpha_1, \ldots, \alpha_n$. There are certain relations between these roots which may be written in the form

(2) $$\phi(\alpha_1, \ldots, \alpha_n) = 0$$

involving, apart from the roots α_r, only rational numbers and rational operations. The relations expressing the coefficients a_r as the elementary symmetric functions of the roots α_s are relations of this kind which are generally known; they remain valid in whatever way we may

* Paper presented at the Twenty-seventh Meeting of the Australian and New Zealand Association for the Advancement of Science, at Hobart, Tasmania, January 1949.

rearrange (permute) the roots. There may be, however, other relations of the type (2) which remain valid only for certain permutations of the roots. The system of all those permutations of the roots $\alpha_1, \ldots, \alpha_n$ under which all relations between these roots are preserved, is called the 'Galois group' of the equation. The system is said to be a 'group' because the composition of two of its elements is always again a permutation of this system.

We notice that this first occurrence of the notion of 'group' is closely connected with the notion of *invariance of a certain system of relations* or identities, invariance under the operations which constitute the elements of the group. The modern theory substitutes, for the relations between the roots the *number field* generated by the roots α_r, the root field of the given equation. To the permutations of the Galois group correspond then the so-called *automorphisms* of this field of numbers.

We shall observe similar conditions in all cases where groups (in the technical sense) occur in geometry, mechanics, physics, etc. So we have in euclidean geometry the group of all motions (displacements) in space (or plane) leaving invariant the distance between any two points. Other branches of geometry could be characterized as the systems of those properties of geometrical figures which are invariant under all transformations of certain groups. This is the fundamental principle of F. Klein's famous *Erlanger Program* (1872). In special relativity we consider the group of all Lorentz transformations leaving invariant the Maxwell equations of electrodynamics. In crystallography we introduce a *crystal group* as the group of all rotations and reflexions which turn a given crystal into itself, the crystal thus taking over the rôle of the root field in the case of the Galois theory. In quantum theory one considers the group of all those transformations of the variables of the wave function under which the Schrödinger differential equation remains invariant.

Apparently quite detached from the theory of Galois, these different propositions contributed more or less to press the development of algebra in one and the same direction. It was reserved to the evolution of the last forty years to recognize the fundamental ideas, common to many of the earlier algebraic investigations, which arose from topics such as those mentioned above. In this way algebra came into its present position, actually permeating all parts of mathematics, pure and applied, including those branches of science where mathematical ideas are employed—as far as economics, chemistry, theory of games —receiving at the same time stimulus for its own further development.

This adaptability of algebra depends on a small number of general principles, two of which we shall discuss here and illustrate by elementary examples. The first of these principles may be called:

The Concentration on the Essential

The first example to be mentioned here is classical. It is the representation of the forces, attached to a fixed point in space, by vectors; i.e., geometrically: – directed straight-linear segments; analytically: – triples of real numbers, the co-ordinates of the endpoint of a segment when the origin of the co-ordinate system is taken coincident with the initial point of the segment, the point of attachment of the force. Vectors are combined according to certain laws which form the body of what is called vector algebra. We 'concentrate on the essential' by taking some of these laws as axioms from which we try to derive the others by logical combinations. Thus we obtain an 'abstract vector algebra' where the vectors are represented by undefined symbols. This concentration is obviously of practical advantage:

1. It covers by the same formalism several seemingly disconnected theories, according to the interpretation of the vectors.
2. It represents a source of meaningful generalizations: the separation from the intuitive basis of geometry or mechanics suggests an extension to spaces of any number, or even to an infinity of dimensions. Every physicist realizes the importance of these generalizations in Mechanics and Physics.

Another theory is based upon the consideration of forces bound to act along a definite straight line. They require for their analytical description six numbers x, y, z, p, q, r, which are related by the condition $px + qy + rz = 0$. The corresponding abstract theory has not been cultivated so far; its geometrical aspects are covered by the researches of Ball, Klein, and Study in line geometry and kinematics.

Further we mention abstract group theory. As a simple example we consider first the group the elements of which are the m different roots of the algebraic equation $x^m = 1$. One of them is the complex number

$$\epsilon = \cos\frac{2\pi}{m} + i \sin\frac{2\pi}{m}$$

and the others are integral powers of ϵ, viz. $\epsilon^0 = 1, \epsilon, \epsilon^2, \ldots, \epsilon^{m-1}$. The composition in this group is the following law:

$$\epsilon^q \epsilon^r = \epsilon^s$$

where s is the least remainder in the division of $q + r$ by m. The unit element of the group is the number 1, and for each element ϵ^r there is an inverse: $\epsilon^{-r} = \epsilon^{m-r}$. In view of these facts we say that the m complex numbers $1, \epsilon, \ldots, \epsilon^{m-1}$ form a *cyclic group* of order m. Generating element of the group is ϵ.

Other systems of the same description are the rotations of a plane about a fixed point when the admitted angles of the rotations are the multiples of $2\pi/m$; and since the combinations are always defined by the addition of the exponent's modulo m, we can say that also the numbers $0, 1, \ldots, m-1$, with the addition modulo m as composition rule, form a group of the same type. The essential of these groups

is in all cases the composition rule; since it is the same in all cases, we say that the groups are '*in abstracto* identical' or 'isomorphic'. Thus a finite abstract cyclic group is completely defined by its order m.

We can only mention here that there are non-cyclic groups of every order m which is not a prime number, and then the order does not define the group; rather there are at least two groups of order $m \neq p$ which are not isomorphic. Establishing all possible non-isomorphic abstract groups of a given order is one of the leading problems in finite group theory.

As another example we mention here the isomorphism which exists between the Galois (permutation) group of an algebraic equation and the group of automorphisms (= isomorphisms with itself) of the root field of the equation. Other algebraic domains also may be dealt with according to the concentration principle, i.e., replaced by abstract systems of symbols. We mention the *fields* where the abstract method, because of its generalizing power, has led to a manifold of interesting extensions. A field is a system of symbols with two different laws of combination which behave like addition and multiplication in number fields. As an interesting consequence of the abstract consideration in field theory we mention here the existence of finite fields; the simplest type of these finite fields is well known from elementary theory of numbers. The p remainders 0, 1, 2, ..., p–1 occurring in the division of all integers by a prime number p, with the addition and multiplication modulo p, form a field of this type. So we have at least one field of order p for each prime p. But whereas for every integer $n > 0$ there is at least one abstract group of order n, no field of order n exists except when $n = p^k$, where p is prime and $k = 1, 2, \ldots$ Moreover, there is only exactly one abstract field of order p^k; i.e., all finite fields of the same order are isomorphic.

Composition (multiplication) of elements in groups is not necessarily commutative. The fact is readily exemplified by the composition of permutations or of linear transformations. This fact may suggest the omission of the commutativity of multiplication from the axioms of field theory. An example of such a non-commutative field had been discovered by HAMILTON: the system of the real quaternions. WEDDERBURN showed that finite non-commutative fields do not exist. By dropping others from the axioms of abstract field theory one obtains further interesting algebraic communities, e.g. rings, integral domains, hypercomplex algebras and non-associative algebras, all of which are objects of extensive investigations.

Addition and multiplication of numbers are not the only operations capable of generalization in abstract communities. Two integers may be combined by forming their greatest common divisor (a,b) and their least common multiple $[a,b]$. It is readily shown that these two combinations are commutative, associative and 'mutually distributive', i.e.

$$(a,[b,c]) = [(a,b),(a,c)],$$
$$[a,(b,c)] = ([a,b],[a,c]).$$

Dedekind began the investigation of abstract communities with two combinations subjected to these laws; he called them 'Dualgruppen'. He found that there are also finite Dualgruppen, e.g. all divisors of the number thirty. Similar communities, now called 'distributive lattices', or BOOLEAN Algebras, have since been studied in abstracto. Examples are the 'algebra of sets' with intersection and union as combinations, and the 'algebra of logic' where the elements are logical statements with '*and*' and '*or*' as combinations (BOOLE, 1854).

Like every method, the 'concentration on the essential' has its bounds. In investigations concerning abstract communities (groups, fields, vector spaces) often it turns out to be expedient to refer to a special isomorphic realization or *representation* in order to derive certain properties. However, not any representation will suit all purposes; so the second principle may be described as:

THE CHOICE OF A SUITABLE REPRESENTATION

The situation may be compared with that of a composer who selects a definite key most suitable for the expression of the musical thought he has in mind: or with the situation of a geometer choosing a certain co-ordinate system in order to make evident certain properties of a geometrical object he wishes to explain.

The 'regular representation' of a finite abstract group by means of permutations had been discovered by CAYLEY in 1854. Let $a_1, a_2, \ldots, a_n$ be the elements of a given abstract group in a fixed order of succession; by multiplying each element in this row by the group element a_r the row is transformed into the row $a_{r_1}, a_{r_2}, \ldots, a_{r_n}$, containing again all elements of the group, but in a new order of succession. This permutation of the group elements, or, which is the same, the permutation of the indices 1, 2, ..., n into $r_1, r_2, \ldots, r_n$, is the permutation to be associated with the group element a_r. The permutations so obtained for each a_r ($r = 1, 2, \ldots, n$) form a group which is isomorphic with the given group; this permutation group is called the regular representation of the given group.

It is often by no means the simplest representation. It is evident that a representation by permutation of degree $<n$ would be preferable for practical calculations with the group elements. But representations by means of linear transformations (or matrices) may also be taken into consideration. For all of them, however, the regular representation is of the greatest importance: they all are built up from certain 'irreducible representations' to be obtained by 'splitting' Cayley's regular representation. For finite groups the representation theory on these lines has been developed by FROBENIUS (1897), BURNSIDE, I. SCHUR, and

E. NOETHER. A well known theorem of abstract group theory which Burnside proved for the first time, making use of representation theory, says that a finite group whose order is divisible by two and not more different prime numbers is always soluble; i.e. isomorphic with a permutation group which as a Galois group may be associated with an algebraic equation whose roots can be represented by means of rational functions and radicals (root operations) of the coefficients of the equation.

Linear representations (matrix representations) of groups are of great importance for those problems in physics where invariants are to be considered. There is, for instance, a one-one correspondence between the (irreducible) representations of the Schrödinger group and the energy levels of the atom. Thus, knowledge of the representations gives a complete classification of all energy levels, at the same time giving a mathematical interpretation for their discreteness.

Group representations are closely connected with *tensors*. Consider the group of all rotations of the 3-dimensional space, given as the group of all linear homogeneous transformations with orthogonal matrix α with positive determinant. Let A be the matrix of a linear representation of the same group which corresponds to the element α. The representation may operate in an n-dimensional space with the co-ordinates $x_1, \ldots, x_n$. By the rotation α (in the original 3-dimensional space) the point x of the n-dimensional space is turned into the point $x' = Ax$. All points x subjected to a certain non-linear algebraic condition, e.g. $\Sigma b_{ij} x_i x_j = 1$, such that for all α also x' satisfies the same condition, viz. $\Sigma b_{ij} x_i' x_j' = 1$, constitute a *euclidean tensor* in the sense of E. CARTAN. In particular, if $n = 3$ and $\alpha = A$, then the condition $x_1^2 + x_2^2 + x_3^2 = l$ is satisfied and characterizes the tensor which is represented by the vectors of length l. Similar conventions can be made with regard to other groups. The rotation group defines by means of its representations the tensors of euclidean geometry and mechanics. A certain representation of the rotation group in a two-dimensional complex space (plane) leads in this way to the so-called spinors, which became significant in quantum theory about twenty years ago. Similarly the tensors of Relativity are defined by means of the representations of the Lorentz group. These are examples of ideas which originally had been conceived in geometry and analysis, the true meaning of which was exhibited later by their algebraic connexion.

UNESCO Programme*

INTERNATIONAL ORGANIZATIONS IN APPLIED SCIENCE (*continued*)

AT the Third General Conference of UNESCO, held at Beirut in November 1948, it was reported that the project for a Permanent Council for the co-ordination of International Congresses of the Medical Sciences had become a joint activity of UNESCO and the World Health Organization. The meeting of the Organizing Committee of the Permanent Council, held in April 1948, had set up an Executive Committee with the tasks of (a) calling a conference early in 1949 to set up the Permanent Council; (b) preparing a draft constitution; (c) collecting information on the structure of the existing international organizations in the field of the medical sciences. Meetings of the Executive Committee were held in April and October 1948, and January 1949. The conference for creating the Permanent Council was summoned in Brussels in April 1949. The interim commission of W.H.O. voted $15,000 for participation in the project in 1948 and the First World Health Assembly made a budgetary allocation of $20,000 for continuing the joint activity with UNESCO in 1949. Contact has been made or maintained with many international organizations in the medical sciences, and close co-operation has been established with W.H.O. in various fields of common interest, such as that of medical and biological abstracting.

As regards Engineering Sciences, the initiative of moving towards a general international organization seems to rest wholly with UNESCO. Whereas, in the World Health Organization and the Food and Agriculture Organization, there are specialized United Nations agencies to which UNESCO can look for collaboration as regards the medical and agricultural sciences (even though no *modus vivendi* has yet been found with F.A.O.), there is no such U.N. agency in relation to engineering science. Moreover, the great Institutions of Engineers, in the United Kingdom and United States and various other countries, are established for separate branches of engineering and do not meet with one another. Recognized international conferences, such as that on Large Dams, and the World Power Conference, though well established, are concerned only with their own subjects. A further barrier to international co-operation exists in the maintenance of trade secrets in engineering science.

A survey of existing international and national engineering societies, for which the World Engineering Conference was given a contract in October 1947, is now being completed. Several outstanding personalities in the engineering world are being asked to prepare reports suggesting methods of furthering international co-operation. Contact with existing international engineering organizations is being maintained. The World Engineering Conference and the World Power Conference have been granted contracts for publications on the problem of Resources. These will be of special interest to the U.N. Scientific Conference on Conservation and Utilization of Resources, which is being held in the United States in 1949.

* This JOURNAL, *10*, 127, 163 (1948); *11*, 2, 43, 57, 72, 94 (1948); 123 (1949).

UNESCO Organization

The structure of UNESCO organization is as follows:

General Conference
|
Executive Board
|
Director-General

Departments (*Programme*) | Bureaux (*Administration*)

There are eight Departments:

1. Reconstruction.
2. Education.
3. Natural Sciences.
4. Social Sciences.
5. Cultural Activities.
6. Exchange of Persons.
7. Exchange of Information.
8. Mass Communication.

It is anticipated that the Department of Exchange of Information will shortly be broken up. The Department of Cultural Activities includes Museums, Arts and Letters, and Libraries. Of interest to natural scientists, are the Library activities as an International Clearing House of Books, and as sponsor of the Book Coupon Scheme. The work of the Department of Natural Sciences itself is organized as follows:

A—Divisions

(i) Field Science Co-operation Offices
(ii) Pure Sciences
(iii) Applied Sciences
(iv) Scientific Literature and Scientific Appliances.

B—Projects

(i) International Institute of the Hylean Amazon
(ii) International Institute of Arid Zones
(iii) Popular Science
(iv) Social Implications of Science
(v) Protection of Nature.

Museums*

Normal museum activities of any particular type are likely to produce different results in different countries. An interesting proposal has been brought forward by UNESCO to provide useful information on museum methods under various conditions. It is proposed to invite a number of museums in different countries to carry out programmes of activities of comparable types, to keep records of them, and to furnish reports for comparison. There are many subjects which could be selected for such an experiment. The results should be of great interest not only to museums but to all who may be concerned with teaching by visual methods, and should furnish a very interesting comparison of the reactions of various peoples to the type of exhibit activity selected for the experiment.

It is perhaps not generally realized that museums available to the ordinary person are, in the world at large, comparatively rare, and that relatively few people have access to them. The term *museum* as used by UNESCO covers a very wide range of institutions, including art galleries; museums of science, technology and history; aquaria; botanical and zoological gardens; nature and wild life preserves; and national parks. Museums in this wide sense can display and interpret things for the instruction and pleasure, on every level, of mankind. One of the aims of UNESCO is to promote the development of the functions of museums in the broad educational field as an addition to their accepted tasks of accumulation and preservation. Encouragement of extension services, to bring some of the benefits of great museums to country centres and even small villages, is part of this problem of widening the opportunities for cultural and intellectual influence.

* From *The Australian Museum Magazine*, 219, 1948.

High Altitude Research

The principle which guides UNESCO in determining upon selected projects which it will foster, is that they should bring together a number of different nations in collaboration. Thus for the Hylean Amazon project, of which so much has been written in the press, the intention is to bring the neighbouring nations to work together on the project and then, once the Institute has been established and put into running order, to withdraw from it and leave it to the nations themselves.

A promising field for the cultivation of international co-operation is receiving attention in relation to High Altitude Research. Scientific expeditions to make physiological and meteorological observations were sent to high altitudes in the nineteenth century. In 1907 the University of Turin established the Institute Angelo Mosso as a permanent research station at Monte Rosa. In 1930 the Institute of Andean Biology was set up in Peru and in 1931 the International High Altitude Research Station was established at Jungfraujoch in Switzerland. Although upper atmosphere research can be conducted by sounding balloons and rockets and by simulating conditions in laboratory chambers, some problems are better dealt with under the less hurried conditions of permanent stations and some can only be dealt with under such conditions.

The physiological and psychological effects of anoxia resulting from high altitude may be studied in decompression chambers only as far as the acute state is concerned, but much work is to be done on the chronic effects. Some remarkable results which have been claimed in the past by the Peru Institute and others, have interested biologists in the chronic effects of high altitude upon different aspects of life. Peruvian airmen are said to fly at 22,000 feet without the need of extra oxygen. Reputed effects upon animal and human reproduction, though doubted or disbelieved by many bi-

ologists, seem to be worthy of investigation. It is claimed that, after the Spanish invasion of the Peruvian high plateaux, it took fifty years of acclimatization before Spaniards could bear children there. Dogs from Calcutta are unable to reproduce in Thibet. White mice taken to the Institute of Andean Biology lost their germinal epithelium.

There are thus physiochemical, physiological and anthropological results of high-altitude life which have still to be discovered, together with human and animal acclimatization. Botanists are interested in the changes which occur in the structure and physiology of plants in the process of acclimatization after transfer to high altitudes. There appear also to be definite sociological characteristics in humans which result from high-altitude life. The traditional military prowess of the Highlander is an illustrative aspect. The large numbers of people living above 2,000 or 3,000 metres include nearly twenty millions in Mexico, over twenty millions in South America, and uncounted millions in Asia from Afghanistan to China.

Meteorological research at high altitudes is concerned with chemical and physical constitution of the air and with air movements, together with the phenomena of icing, the production and characteristics of fog and mist and the effect of meteorological conditions upon snow and glaciers. The enormous increase in the intensity of cosmic radiation at high altitudes means that many problems related to cosmic rays are properly studied only at high altitude stations. Certain astronomical, especially astrophysical, problems are also most efficiently investigated at high altitudes. Conservative scientists who have some doubt of the reputed biological effects at high altitude, believe that the research which should be of greatest immediate value, at high altitudes, is (a) to complete the spectrum of cosmic rays and (b) to study the corona of the sun.

The General Conference of 1947 instructed the Director-General to convene a special international conference to make recommendations to UNESCO and to the United Nations concerning High Altitude Research Stations. This conference met at Interlaken, Switzerland, from 31 August to 3 September 1948 and included an excursion to the Jungfraujoch Station. Delegates attended from the United Kingdom, France, India, Peru, Switzerland, Austria, Italy and the Netherlands. There were also representatives from the International Council of Scientific Unions, the International Astronomical Union, the International Union of Geodesy and Geophysics, the International Union of Biological Sciences and the Jungfraujoch Station. UNESCO was represented by Wang Ghing-Shi, Joseph B. Reid and Frank J. Malina. Dr. Wang, who is in charge of the Pure Sciences Division of the Natural Sciences Department of UNESCO, organized the Conference and acted as its secretary.

The delegates at the conference agreed that if plans for research laboratories and observatories under the auspices of the United Nations are adopted, a high priority should be given to high altitude stations. In the meantime they resolved, firstly, that the I.C.S.U. might appropriately set up a Mixed Commission, composed of the I.A.U., I.U.G.G., I.U.B.S. and I.U. Pure and Applied Physics, to facilitate exchange of information. They further resolved that organizations interested in international scientific co-operation should be asked to give support to the work, both moral and financial. The conference agreed that the existing high altitude stations of the world, and additional stations to be established, should be organized into a network. The delegates also proposed that grants for travelling expenses should be provided to selected scientists anxious to visit high altitude stations for research and study.

At the Beirut General Conference in November 1948, the delegate of Peru extended an invitation for a Symposium on High Altitude Biology to be held at Lima in 1949. He offered the facilities of laboratories in Peru.

The Edgeworth David Medal

THE first award of the Edgeworth David Medal, which is given for published research in Australian science by a scientist under the age of thirty-five years (This JOURNAL, *11*, 88), is shared between R. G. Giovanelli, of the C.S.I.R. Division of Physics, and Ernest Ritchie, Senior Lecturer in Chemistry in the University of Sydney. This is the 1948 award, which is for the field of Mathematics, Physics, Chemistry, Astronomy, Meteorology, Engineering, and related sciences.*

In 1939–40 R. G. GIOVANELLI published the results of observations upon solar chromospheric flares, which he had made at the Commonwealth Observatory, Mt. Stromlo. Although such flares had been observed and recorded for many years, no theory which could be regarded as at all acceptable had been proposed to account for their origin. In 1946 Giovanelli propounded a quite original conception in the form of a quantitative electromagnetic theory which accounts for their main properties. In 1947–48 he proceeded to develop novel theoretical investigations of other aspects of the constitution of the sun's atmosphere and of the processes responsible for its properties; including an assessment of the proportions of the hydrogen atoms which are ionized or are excited to the various quantum states. His calculations on emission from the chromo-

* The 1949 award is to be in the field of Geology, Botany, Zoology, Physiology, Biochemistry and related sciences. The 1950 award is to be in the field of Psychology, Anthropology, Sociology, Economics, Geography and related sciences; thereafter by triennial rotation.

sphere are the first which take account of collisions in the chromosphere as distinct from the corona. His work on electric fields associated with change of flux in sunspots has been favourably noticed by prominent astrophysicists overseas, and shows considerable promise of development.

Other workers in some of the problems which Giovanelli has tackled base their theory upon the assumption of different conditions; some of his work awaits further check. He has distinguished himself especially for inventive resource, and for skill and learning in elaborating the physical theory of his ideas. He presents pioneer work which has opened up several directions for further exploration: some of them (such as heat transfer in the upper chromosphere and corona, and the ejection of prominences from sunspots) have already been pursued by Giovanelli in work not yet published. His ideas may be expected to stimulate further work by others; some of them (such as the processes which lead to very fast electrons in the sun's atmosphere and suggestions concerning a sufficient cause of the transport of matter in prominences) are likely to be of permanent value. Giovanelli's work has been published in the *Astrophysical Journal*, in *Nature*, in the *Monthly Notices* of the Royal Astronomical Society, and in the *Australian Journal of Scientific Research*.

ERNEST RITCHIE worked in Sydney during the period 1937–38 with G. J. Burrows, pioneer of complex inorganic chemistry in Australia, and he was associated with him as junior author in publications. During the years 1938–40 he was associated with F. Lions and others in various published research problems in organic chemistry. One of these, for example, comprised an unequivocal synthesis of nornicotyrine, by clear and simple reactions. This is the key intermediate in Pictet's classical synthesis of nicotine, and the work thus constitutes a synthesis of nicotine.

Ritchie alone then published a series of eight papers on the chemistry of phenanthridine. They form a very substantial contribution to a little-explored part of heterocyclic chemistry. Starting with known reactions, Ritchie prepared many new compounds and improved the reactions and methods considerably. This work is of considerable extent and of solid character, based on facts which will find their way into any textbook or review dealing with the phenanthridines. Thus the scope of the Morgan–Walls reaction was examined and a mechanism suggested; and the reaction was used to prepare derivatives which included the parent base of the chelidonine group of alkaloids. Reactions of dihydrophenanthridine and of 9-formylphenanthridine were studied in general. In the course of developing a method of converting primary aromatic amines through diphenylindole derivatives to those of fluorene, certain unexpected by-products of the Clemmensen reduction were isolated and their constitutions established.

In 1948 Ritchie, in conjunction with R. M. Gascoigne and D. E. White, published a survey in which the anthocyanins in over three hundred native Australian flowers and fruits were identified, and the classified results were compared with those of previous overseas surveys. The distribution of the three anthocyanidin types was found to differ widely, and an explanation was given in terms of mutation, supported by recent genetical work. The whole of the nineteen papers in which Ritchie's work had been published up to that date appeared in the *Journal* of the Royal Society of New Wales.

Recently, with E. Anet and G. K. Hughes, Ritchie has published in *Nature* a brilliant and elegant synthesis of hygrine and cuscohygrine, the latter of which had not previously been synthesized—indeed, its constitution had been in doubt. The synthesis, which uses an idea suggested some time ago by Sir Robert Robinson, is a one-step reaction carried out in dilute, neutral, aqueous solution at room temperature; it has aroused considerable interest. A successful continuation of work in this field would establish Ritchie as an authority in the synthesis of alkaloids under physiological conditions. The award, however, is made to him largely in recognition of his work on the phenanthridines, together with the thoroughly reliable nature of the research results which he has established, and the excellence of their published presentation.

News

The James Cook Medal

THE James Cook Medal for 1948 has been awarded to Bernado A. Houssay, of the Institute de Biología y Medicina Experimental, Buenos Aires.* The medal is given annually for contributions to science and human welfare in the Southern Hemisphere. (This JOURNAL, *10*, 140.) Houssay has done much work on the endocrine glands, snake and spider venoms, hypertensions, etc. His most noted work is in connexion with the effect of the pituitary upon the carbohydrate metabolism of the body. He showed that it is the anterior lobe of the pituitary which is concerned (not the posterior, as previously supposed) and that it has a diabetogenic action which opposes the

* Houssay was formerly Professor of Physiology in the University of Buenos Aires. He was removed from office by the 'Intervener' appointed by the Argentine dictatorship to control the University, because of his stand for the freedom of research. Some 1,073 members of the faculties of Argentina's six universities had been retired from their posts by 1947, or had resigned in protest. In a joint document they state: 'Through the imposition of the new laws, the Free University will disappear, and with it justice and right for the professors, freedom to teach, and stimulus to investigators who will never feel secure in their classrooms and laboratories. . . . The universities will have ceased to be fountains of learning and will have become mere technical schools and mouthpieces for the bureaucracy of the Government.' (*Science*, *107*, 167; *Nature*, 23 November, 1946.)

action of the insulin from the pancreas. Thus carbohydrate oxidation was proved to occur in a dog from which the pancreas had been removed, provided that the anterior lobe of the pituitary was also removed.

The Nobel Prizes

THE Nobel Prize for Physics has been awarded to P. M. S. Blackett, Professor of Physics in the University of Manchester. From his development of the automatic, and later the counter-controlled, cloud expansion chamber, Blackett opened fields of research in nuclear processes and the physics of cosmic radiation.

The Nobel Prize for Chemistry has been awarded to Arne Tizelius, of the Physical Chemistry Institute at Uppsala. His chief work has been in the measurement of the electrical properties of proteins and the electrophoretic analysis of biological substances. Following the introduction of chromatography, he has recently advanced the knowledge of the underlying principles of adsorption, to provide corresponding methods of analysing colourless substances.

The Nobel Prize for Medicine has been awarded to Paul Muller, who discovered the effects of D.D.T. as an insecticide. The discovery was made while he was one of a team in the Basle laboratories of J. R. Geigy, S.A., working on a research into insecticidal chemicals, which lasted more than twenty years.

The Royal Society

Vice-Presidents of the Royal Society for the year 1949 are: Sir Thomas Merton, Treasurer of the Society; Sir Edward Salisbury, Biological Secretary of the Society and Director of the Royal Botanic Gardens, Kew; Sir James Chadwick, Master of Gonville and Caius College, Cambridge; Professor A. C. Hardy, Linacre Professor of Zoology in the University of Oxford.

The Alan Johnston, Lawrence and Moseley Research Fellowship for 1949-50 (renewable for a further three years) has been awarded to Robert Barer of the Department of Human Anatomy, Oxford. He will continue work on new methods of microscopy, with special reference to the Burch reflecting microscope.

The Royal Medals for 1948 were awarded to Professor Harold Jeffreys (geophysics and solar system astronomy) and Professor James Gray (cytology, ciliary movement, animal posture and locomotion). The Copley Medal was awarded to Professor A. V. Hill (myothermal problems and biophysical phenomena in tissues); the Rumford Medal to Professor F. E. Simon (low temperatures); the Davy Medal to Professor E. L. Hirst (structure of starches, sugars, plant gums and vitamin-C); the Darwin Medal to Professor R. A. Fisher (theory of natural selection, concept of the gene complex, evolution of dominance); the Hughes Medal to Sir Robert Watson-Watt (atmospheric physics and radar).

Professor K. E. Bullen, F.R.S.

Professor Keith Edward Bullen has been elected Fellow of the Royal Society of London. Professor Bullen, who occupies the Chair of Applied Mathematics in the University of Sydney, is a world authority on seismology. In collaboration with Professor Harold Jeffreys, F.R.S., of Cambridge, he produced the earth-wave travel-time tables which are accepted as standard and are used for the interpretation of seismographic records. Other extensive work in Geophysics by Jeffreys and Bullen has revolutionized older views on the constitution of the earth's interior.

The Cambridge University Press has recently published Professor Bullen's book, *Introduction to the Theory of Seismology*, which appears to be the only book of its kind ever written. It is an impressive exposition of the modern transformation of seismology from an empirical subject into an exact science.

H. R. Marston, F.R.S.

Hedley R. Marston, Chief of the Division of Biochemistry and General Nutrition, Council for Scientific and Industrial Research, Adelaide, has been elected Fellow of the Royal Society of London. The laboratory of which he is in charge has been responsible for work upon the function of trace elements in the food of merino sheep. It was shown, for example, that coast disease is a result of the absence of cobalt, and that 'steely' wool could be eliminated by feeding small quantities of copper. Recent investigations have shown that the Ninety Mile Desert region of South Australia may be redeemed for use as pasture land by adding traces of copper and zinc; thus bringing into productivity more than two million acres of low-rainfall country. In 1948 Mr. Marston visited London at the invitation of the Royal Society to deliver an address on his work.

Royal Society of N.S.W.

The Clarke Medal for 1949 has been conferred upon the Rev. Montague Rupp in recognition of his work upon Australian orchids. In addition to many papers, Mr. Rupp has published an excellent illustrated book on the Orchidaceae.

At its annual meeting the Royal Society of N.S.W. elected to Honorary Membership Sir Harold Walter Florey, Kt., F.R.S., M.D., B.S., M.A., B.Sc., Ph.D., Nobel Laureate, Professor of Pathology in the University of Oxford; and Professor Frank Macfarlane Burnet, F.R.S., M.D., Sc.D., Director of the Walter and Eliza Hall Institute of Medical Research, Melbourne. Only on very few occasions has Honorary Membership of the Society been conferred upon a resident in Australia. Professor Burnet was awarded the Walter Burfitt Prize by the Society in 1938.

Professor W. L. Waterhouse

The Royal Society of New South Wales has awarded the Society's Medal to Professor Walter Lawry Waterhouse, M.C., D.Sc.Agr.,

D.I.C., F.L.S. The Medal is given to a member of the Society for a meritorious contribution to the advancement of science, made especially through the activities of the Society. It was last awarded to Edwin Cheel, in 1943. Professor Waterhouse has also been awarded the Medal of the Australian Institute of Agricultural Science.

His work has in general been directed to solving problems of cereal diseases in Australia. It has been characterized by the coordination of a complete and thorough programme of fundamental investigation with a programme of research towards an applied objective. His main work has been to produce a wheat which would be resistant to rust, without losing other desirable characteristics. Through a continuous survey of the various races of rust throughout Australia, and an investigation of their spread through the crop area, he discovered races not separated by the standard American differential hosts and thus he established Australian differentials. His discovery of new races, some in the actual course of being produced, led to the realization that the cause of breakdown of rust resistance in varieties such as *Eureka* lies in the appearance of new races.

The actual key to the production of suitable rust-resistant wheats lay in finding varieties of common wheat which would cross with *Khalpi*, a fully resistant variety. Workers in various parts of the world had failed to do so in repeated attempts. Waterhouse eventually succeeded with *Steinwedel* and derivatives, and so suggested a track which has been followed by workers overseas in crossing other varieties, such as *Timopheevi*. His extensive fundamental and applied investigations eventually led to the production of the *Kendee* and *Gabo* varieties, released in 1943. In that year Waterhouse was awarded the Clarke Medal of the Royal Society of New South Wales. Subsequent tests have shown that Waterhouse incorporated in *Gabo*, through his patient selection and testing, both a yield which far exceeds that of any comparable variety, and baking qualities of the highest order. It has set a new standard in Australian wheat varieties.

Waterhouse has extended his work to the incidence of rust on other cereals, such as flax, linseed and maize. He has inspired large numbers of students in his subjects of Plant Pathology, Plant Breeding and Genetics, and has freely given meticulous attention to problems continually brought to him by agricultural scientists and by the agricultural community in general. He was President of the Linnean Society of N.S.W. in 1935, of the Royal Society of N.S.W. in 1937, and of Section K of A.N.Z.A.A.S. in 1939. His work has been published chiefly through the *Journal* of the Royal Society of New South Wales.

Royal Society Delegation

The Royal Society of London appointed a delegation of six of its Fellows to attend the Seventh Pacific Science Congress in New Zealand in February. They were: Dr. G. E. R. Deacon, F.R.S., Hydrologist, Discovery Committee, Colonial Office, and Senior Principal Scientific Officer, Royal Navy Scientific Service; Sir Norman Haworth, F.R.S., Professor of Chemistry in the University of Birmingham from 1925 until his retirement last October; Professor H. D. Kay, C.B.E., F.R.S., Research Professor of Chemistry, University of Reading, and Director, National Institute for Research in Dairying, University of Reading; Professor G. W. Robinson, F.R.S., Professor of Agricultural Chemistry, University College of North Wales, Bangor; Sir Geoffrey Taylor, F.R.S., Yarrow Research Professor of the Royal Society; Professor C. M. Yonge, F.R.S., Regius Professor of Zoology in the University of Glasgow.

Sir Norman Haworth and Sir Geoffrey Taylor have spent some time since the Congress in visiting Australian university laboratories at the invitation of the National University. During a brief stay in Sydney, Sir Norman delivered the Liversidge Lecture of the University of Sydney, upon Sugar as a Raw Material for Organic Compounds. In the latter part of March he conducted a seminar in carbohydrate chemistry in the University of Adelaide. His lectures in Adelaide referred particularly to the chemistry of vitamin C, the structure of cellulose and of starch, the structure of bacterial polysaccharides, and problems in the field of immunology. On 28 April he gave a public lecture in the University of Melbourne on 'The Place of Science in Education'. On 4 April he addressed the Victorian Society of Pathology and Experimental Medicine on 'Immuno-chemistry and the Structure of Bacteria'.

Sir Geoffrey Taylor gave a public lecture in the University of Melbourne on 5 April on 'Recollections of a Scientist'. In the University of Sydney, commencing on 26 April, Sir Geoffrey will deliver the G. A. Taylor Memorial Lectures and the Geoffrey Sulman Memorial Lectures. The subjects will include plasticity, turbulence and the mechanics of explosions. He will conduct a symposium on elasticity in the University of Melbourne during the May–June vacation.

International Congress of Mathematicians

The Congress which is to be held in Cambridge, Mass., from 30 August to 6 September 1950 (This Journal, *11*, 127), will be the first international gathering of mathematicians since 1936. It takes the place of a congress originally planned by the American Mathematical Society for the year 1940. Harvard University will be the host institution, but various institutions in metropolitan Boston will arrange special features. The Congress will include conferences in several fields; addresses by outstanding mathematicians; and contributed papers on Algebra and Theory of

Numbers, Analysis, Geometry and Topology, Probability and Statistics with Actuarial Science and Economics, Mathematical Physics and Applied Mathematics, Logic and Philosophy, History and Education. The official languages will be English, French, German, Italian and Russian.

The Chairman of the Organizing Committee is Professor Garrett Birkhoff of Harvard and the Vice-Chairman is Professor W. T. Martin of M.I.T. Professor J. R. Kline of Pennsylvania is the Secretary of the Conference. Mathematicians from overseas will be accommodated without charge in the dormitories and dining rooms of Harvard University. Special arrangements are being made to reduce the cost of travel; congress membership fees are yet to be announced. The address of the Secretary is 531 West 116th Street, New York City 27, N.Y.

Before the Congress commences, an independent meeting of mathematicians will be held in Boston or Cambridge (Mass.) with a view to the re-establishment of the International Union of Mathematics, which was disrupted by international disagreements after the first world war.

Specialist Conference in Agriculture

The programme of the British Commonwealth Scientific Official Conference on *Plant and Animal Nutrition in Relation to Soil and Climatic Factors* (This JOURNAL, *11*, 53) has been arranged in four sessions (A to D) at Adelaide from August 22 to 31, and two sessions (E, F) at Canberra from 13 to 15 September 1949, as follows:

- A—Review of present knowledge of the climatic and soil factors affecting nutrition of plants and animals.
- B—Effects of specific soil and climatic factors on the nutrition of plants.
- C—Nutrition problems of the animal as determined by plant and soil.
- D—Influence of plant and animal on soil fertility.
- E—Review.
- F—Recommendations.

In addition to the official programme tour between Adelaide and Canberra, arrangements are being made for short pre-Congress and post-Congress tours in the various States and New Zealand.

A limited number of observers will be admitted to the Conference, as well as the official delegates and invited contributors. Papers up to 2,000 words, and summaries or abstracts up to 500 words were accepted by the Committee without invitation before the early part of March. Copies of papers will be distributed in advance, so that they need not be read to the Conference before they are discussed. The Conference Committee in Australia comprises: Dr. I. Clunies Ross, Dr. L. B. Bull, Dr. B. T. Dickson, H. R. Marston, F.R.S., Professor H. C. Trumble, J. K. Taylor and Dr. H. C. Forster (Secretary). Communications should be addressed to the Secretary, care of the C.S.I.R.O., Melbourne.

British Association—1949 Meeting

The 1949 meeting of the British Association for the Advancement of Science will be held at Newcastle-on-Tyne from 31 August to 7 September. The President will be Sir John Russell, the soil chemist. Sir John was head of the chemical department of the Wye Agricultural College from 1901 to 1907; soil chemist to the Goldsmith Company from 1907 to 1912; Director of the Rothamsted Experimental Station from 1912 to 1943; and also Director of the Imperial Bureau of Soil Science from 1928 to 1943. From 1941 to 1945 he was Chairman of the Agriculture Sub-Committee for Europe of U.N.R.R.A.

Defence Services Research Facilities Committee

On the initiative of the Council of the Royal Society, a Committee has been established 'to consider proposals for the use of Service facilities and personnel for assisting scientific research, and to make recommendations to the Council of the Royal Society, the Lords Commissions of the Admiralty, the Army Council and the Air Council'. The Chairman of the Committee is Sir Geoffrey Taylor, the Yarrow Research Professor of the Royal Society. The Committee proposes to conduct its business through panels of scientists and Service representatives interested in specific projects, as follows:

(*a*) Submarine gravity measurements;
(*b*) Surplus explosives;
(*c*) Magnetic survey;
(*d*) Aerial photography;
(*e*) Scientific expeditions.

Scientists wishing to submit proposals for consideration should approach the Assistant Secretary, The Royal Society, Burlington House, London W.1.

The Committee is constituted of Professor P. M. S. Blackett, F.R.S., Sir Harold Spencer Jones, F.R.S., Dr. A. C. Menzies, and F. S. Russell, F.R.S. (Royal Society); Vice-Admiral A. G. N. Wyatt and F. Brundrett (Admiralty); Lieut.-General Sir Kenneth Crawford and Dr. O. H. Wansbrough-Jones (War Office); Air Vice-Marshal C. E. N. Guest and G. S. Whittuck (Air Ministry); F. J. Wilkins and H. M. Garner (Ministry of Supply).

American Scientists in British Colonies

Dr. F. Dixey, Geological Adviser to the Colonial Office, is discussing with the head of the United States Geological Survey the appointment of some fifty American scientists to work in British Colonies. Owing to the war effort, the British Commonwealth is short of the required specialized scientists—mainly geologists and geodetic engineers. The Directorate

of Colonial Geodetic and Topographical Surveys was established in 1946, in the hope of completing accurate maps of the Colonies within ten years. Since then, nearly 300,000 square miles of Africa have been covered by photographic survey.

The geodetic engineers will work mainly in East and Central Africa, to produce topographic knowledge for the development of rail and road communications. The geologists will be engaged chiefly in making basic geological survey maps in colonies such as Nigeria (tin, columbite, coal, gold, lead, iron); Sierra Leone; Uganda (gold, tin, tantalum, columbium, oil); Kenya (gold, soda, kyanite); Tanganyika (diamonds, tin, mica, coal); Sarawak (coal); British Guiana (bauxite, gold, kaolin).

Scholarships and Fellowships

The Universities of Cambridge and Manchester invite applications, before 30 April, for Imperial Chemical Institute Fellowships valued at £500 to £850. The University of Manchester invites applications, before 30 April, for Turner and Newall Fellowships, valued at £600 for three years, in Engineering, Inorganic Chemistry and Physics. Trinity College, Cambridge, invites applications, before 1 May, for Dominion and Colonial Exhibitions valued at £40 per annum and for Research Studentships valued at £375.

The Royal Commission for the Exhibition of 1851 invites applications, before 1 June, from British subjects under twenty-six years of age, who are graduates of Dominion universities, for research scholarships tenable for two years at £350 per annum. The Royal Institution of Great Britain offers scholarships under similar conditions to graduates trained in research, valued at £350 and tenable at the Davy Faraday Research Laboratory, London. The British Council invites applications for two scholarships for study in Britain for two years, to be awarded (without age limits) to condidates who show ability to benefit from training overseas.

Directory of Australian Chemicals

Data collected during the war and recently brought up to date with the co-operation of manufacturers, dealing with over four hundred chemicals now made in Australia, has been compiled by Dr. F. H. Campbell, Chemical Adviser of the Division of Industrial Development of the Australian Department of Post-War Reconstruction. The chemicals are listed alphabetically, with the names of the respective manufacturers who make them. The names and addresses of manufacturers are also given alphabetically. Many new heavy chemicals, new drugs and plastics are included. The number of chemical factories in Australia increased from 238 to 362 in the 1939-46 period, and the number of employees increased from 5,346 to 10,530, while the value of output rose from seven million to nineteen million pounds. (*Directory of Australian Chemicals*, 50 pp., reproduced typescript. 6″ × 8¾″, paper covers. Available in each State. Price, 5*s*.)

Technical Information from the Enemy Countries

The Division of Industrial Development of the Australian Ministry of Post-War Reconstruction has issued a series of Abstracts of selected reports of the Scientific and Technical Missions to Germany and Japan, under the title *Technical Service to Industry*. The publication of these Australian Abstracts ceased with List No. 17, which was issued in December 1948. Complete lists of *Reports on German and Japanese Industry* have been issued from time to time by His Majesty's Stationery Office, London, in title form only—the latest being Classified List No. 18, published March 1948, which consolidates and supersedes the previous issues.

Unabridged copies of all (except a few) of the original Reports are available from the Division of Industrial Development (203 Collins Street. Melbourne C.1; Box 2931), on free loan. Copies of Reports are also available for reference in the main public libraries. Copies of German documents and drawings of tools and equipment are also available in the Division. Microfilm copies are obtained and projected without charge, on application; or photostats may be obtained at 2*s*. or 4*s*. per frame according to the degree of enlargement. There is a Deputy Director of the Division of Industrial Development and/or a State Liaison Officer of the Secondary Industries Commission in each capital city of Australia: application may be made direct to these.

Resistance to Marine Borers

The property which confers upon Australian turpentine, *Syncarpia laurifolia*, its reputation for immunity from marine borers, has been identified by the C.S.I.R. Division of Forest Products. Although other countries had established their own plantations of the tree to supply their port installations, it was found in Hawaii, when the locally grown trees at length matured and were tried, that they were not immune. The C.S.I.R. workers discovered that the Hawaiian-grown turpentine lacked the particles of silica which occur in the wood tissue of the home-grown tree. This discovery led to an examination of timbers from all over the world, which showed that some five hundred types contain silica particles—many with more than the turpentine itself. Some of them are identified with timbers chosen for boat-building by natives in the tropical islands to the north of Australia.

In view of the usual reluctance of timber millers to handle turpentine because it so quickly blunts their saws, it is suggested that a similar effect upon the teeth of borers would make them powerless to grind their food supply. The Council's results should provide a ready guide to timbers likely to be resistant to

borers, and may lead to methods of immunizing susceptible timbers by impregnating them with silica.

The National University

Research Fellowships in the Social Sciences have been awarded to T. G. H. Strehlow, of Adelaide, and to G. T. J. Wilson. Mr. Strehlow is to continue for two years his present work on languages and customs of Central Australian aborigines and to prepare his work for publication—including a book of aboriginal chants. Mr. Wilson, who is a graduate of New Zealand and Cambridge, and who has been Senior Lecturer in History in the University of Tasmania, is to spend one year in research upon the federal system of Free India.

A Fellowship in Demography has been awarded to W. D. Borrie, of Sydney, who will continue his work on the historical demography of Australia. Mr. Borrie is at present working on this subject under the direction of Professor Glass of London, but will return to Australia during 1949. A study of the social structure of tribes in the Madang area, New Guinea, with particular reference to customary law, was commenced in March by P. Lawrence, a scholar of the National University, who has obtained honours in Anthropology in Cambridge.

Dr. F. J. Fenner, formerly Haley Research Fellow at the Walter and Eliza Hall Institute and recently on a Rockefeller Fellowship in America, has been appointed to the Chair of Microbiology in the University. Professor D. B. Copland, Vice-Chancellor of the University, has been elected Member of the American Philosophical Society.

University of Melbourne

Dr. P. L. Henderson has been appointed to the Chair of Mechanical Engineering. He is a barrister-at-law of the Inner Temple, London, and holds the degrees of Master of Engineering, Sydney, and Doctor of Philosophy, Cambridge. After working as a railway engineer in New South Wales, he spent some years in British railways and has latterly been chief engineer and consultant for manufacturing firms in Australia. G. J. Thornton-Smith, who has been senior lecturer responsible for the teaching of Surveying since 1940, has been appointed to the rank of Associate Professor in charge of a newly created Department of Surveying, with institution of the new degree course in Surveying. W. Macmahon Ball, whose previous appointments have included that of representative of the British Commonwealth on the Allied Control Council of Japan, with the rank of Minister, has been appointed as the first Professor of Political Science in the University. C. M. Tattam, senior lecturer in Mineralogy and Petrology, has been appointed Associate Professor of Geology.

Other appointments include: I. C. Heinz as senior lecturer in Pathology; K. H. Pausacker as senior lecturer in Organic Chemistry; E. K. Horwood as lecturer in French and German in the Faculty of Science; F. E. Emery as lecturer in Psychology; J. C. Hayden as Stewart Lecturer in Medicine, and A. E. Coates as Stewart Lecturer in Surgery, both for an initial term of five years; R. O. Cherry and H. F. Dunbar as lecturers in Physics; D. Cochrane as senior lecturer in Mathematical Economics; E. Stephenson as lecturer in Chemistry.

In the list of New Year Honours, knighthoods were conferred on Sir Bernard Heinze, Kt.B., Ormond Professor of Music, and on Sir John Behan, Kt.B., formerly Warden of Trinity College. Professor A. B. P. Amies, who served during the recent war with the plastic surgery unit and elsewhere, received the C.M.G. for distinguished public service. At a ceremony in the Professorial Board Room on 19 January, Lord Nuffield received the honorary degree of Doctor of Laws. The first award of the degree of Doctor of Philosophy through the Department of Chemistry has been made to C. C. J. Culvenor, for work on the chemistry of the ethylene sulphides. Dr. Culvenor is now working in the Dyson Perrin Laboratory at Oxford. The degree of Doctor of Science has been conferred on V. D. Hopper, senior lecturer in Physics, for a series of published works dealing with experiments on the electronic charge and its determination by the oil-drop method. Dr. Hopper was last year awarded a Nuffield Foundation travelling fellowship and is at present working under Professor Oliphant at Birmingham.

Bequests and benefactions recently received by the University include: £100 and books and plants for the Botany Department, from Dr. H. G. Breidahl; £50 from Myer Emporium towards the expense of sending junior staff members to the Hobart meeting of the A.N.Z.A.A.S.; ten guineas each from Cable Makers Australia and from Wyeth Incorporated, for renewal of annual prizes; a 200-k.v. X-ray plant for the Department of Physics, from Dr. Frank Stephens and Dr. E. R. Chrisp; £2920 from the estate of William Pomeroy Green, to be applied in the promotion and encouragement of cancer research; £500 from a new bequest in the estate of Thomas Maughan, towards teaching and research in Metallurgy; £250 from the State Electricity Commission, as renewal of yearly grant to the Department of Botany for the study of fossil pollen; £100 from Broken Hill Associated Smelters, for research on acidosis and alkalosis of the kidney, in the Department of Physiology; £350 from South Australian Gas, as a renewal of payment for further research in connexion with Experimental Lurgi Gas Plant; £20 from Burroughs Wellcome for renewal of annual prize; ten guineas from W. K. Burnside Pty. for the Department of Bacteriology; £100 from Australian Paper Manufacturers Ltd. for work in the Department of Bacteriology; £300 from E. J. L. Gibson to establish a prize in Engineering; £250 from Electrolytic Zinc Co. of Australasia, towards Professor Greenwood's travelling expenses, and £500 from the same

Company for use at the rate of £100 per annum for travelling expenses of staff members of the Departments of Mining and Metallurgy; £928 from *The Herald* newspaper towards the emoluments of the Chair of Fine Arts; and sums from 16 other benefactors totalling £1787, as well as gifts in kind. The seventh monthly instalment of £100 for research in the Department of Physiology has been received from Mr. L. Rubenstein.

During the week from 21 to 28 May, the Graduates' Section of the University Union will present for the first time a series of activities known as Graduates' Week. The programme will include a University Banquet, an Exhibition of Current Research in various scientific departments, a sports day, a play in the Union Theatre, a public discussion on some of the problems facing the University in the community and an evening of documentary films produced by members of the University staff. A course of lectures and practice classes in Statistical Methods for Research Workers is being given by the Department of Statistics during the first and second terms.

University of Queensland

R. P. Cummings, who was appointed to the staff in 1935 and made senior lecturer in 1945, has been appointed as the first Professor of Architecture. Mansergh Shaw, of the University of Melbourne, has been appointed to the Chair of Mechanical Engineering. Associate Profesor Hugh C. Webster has been appointed to the Chair of Physics. Professor Webster, who is a graduate of the University of Tasmania, and who did post-graduate work in Melbourne under Professor Laby and later at Cambridge, was appointed lecturer in Biophysics in the University of Queensland in 1936. During the war period he was attached to the C.S.I.R., and was for some time liaison officer abroad. Other appointments include those of Professor W. V. Macfarlane to the Chair of Physiology; P. R. Salisbury as lecturer in Naval Architecture (the first Australian appointment in the subject); W. B. Mather, assistant lecturer in Zoology.

The University's first ordinary award of the degree of Doctor of Medicine has been conferred upon R. K. Macpherson, lecturer in Physiology. In a thesis upon Tropical Fatigue, based on war-time observations of service personnel, he shows that the strain of living in a humid tropical climate is to be measured largely by its psychological effects. The most important physiological effect is that of skin disorder, which is likely to be the factor limiting ability to live in such a climate.

The degree of Doctor of Science has been conferred upon Owen A. Jones, lecturer in Geology. J. H. Green, formerly assistant lecturer in Chemistry, who has published research upon oxygen-18, has commenced work under Professor H. J. Emeleus in Cambridge, as a holder of a Research Studentship from the Australian C.S.I.R. He will study chemical problems involving the use of radioactive tracer elements. Noel J. de Jersey, who was awarded a C.S.I.R. Fellowship after graduating in Queensland, has gained the degree of Doctor of Philosophy from the University of London. He has been engaged on investigation of properties of Queensland coals, in the Fuel Technology Department of the Imperial College. Professor S. F. Lumb has been elected a Fellow of the Royal College of Surgeons, London.

The Senate has authorized the establishment of a University of Queensland Press. Its main function will be to publish textbooks, laboratory manuals, and works of academic or literary interest, together with official University publications. The Press will also conduct bookshops, in the city and at St. Lucia, for the general needs of students. A comprehensive plan of University expansion and development is being prepared for the Senate. Among other proposals under consideration are those for the establishment of a Faculty of Education, and for the extension of the operations of the Department of External Studies in co-operation with the State Government's planning of regional development and devolution of administration. The Department of Geology has received a benefaction of books, maps and specimens collected by the late C. E. Saint-Smith. Benefactions have also been received by the Medical Library, the Fruyer Library fund, and the Thomas Thatcher Memorial Library. The Zinc Corporation has granted a sum of £5000 to the University to establish a post-graduate scholarship, to be awarded in mining, metallurgical or geological subjects.

The Queensland Government has decided to give a pound-for-pound subsidy to church authorities to assist them to build new Colleges in conjunction with the establishment of the University at St. Lucia. The St. Lucia site was used for the first time for the matriculation ceremony held in March, when some 580 new students were received. Construction work, which was interrupted during the war, is now nearing completion.

University of Adelaide

Professor L. G. H. Huxley arrived in Adelaide in February to take up duty as Elder Professor of Physics in succession to Sir Kerr Grant, who retired at the end of 1948. Professor Huxley was the Rhodes Scholar from Tasmania for 1923. For the next five years he was at Oxford as student, demonstrator and lecturer. His principal appointment before the war was head of the Department of Physics in University College, Leicester, from 1932 to 1940. Then for six years he worked with the Telecommunications Research Establishment. In March 1946 he was appointed Reader in Electromagnetism in the Electrical Engineering Department of the University of Birmingham, of which Department he was the acting head at the time of his appointment to the Adelaide Chair.

Professor J. McKellar Stewart, formerly Vice-Chancellor of the University, was awarded the C.M.G. in the New Year Honours. Two new buildings have now been completed for the teaching of Engineering, and others for Geology and Anatomy. The University embarked in 1945 upon a building programme estimated to cost £600,000.

University of Tasmania

Recent appointments are: H. P. Tuck as Associate Professor in charge of the Department of Electrical Engineering; J. C. Jaeger as Associate Professor of Mathematics (at present Acting Professor); F. D. Cruickshank as Associate Professor of Physics; G. J. Burrell as senior lecturer in charge of the Department of Mechanical Engineering.

The University has fixed seventeen years as the minimum age for entry of students—as has been the practice in the University of Melbourne.

Professor D. H. K. Lee

Professor D. H. K. Lee has left the Chair of Physiology in Queensland to become Professor of Physiological Climatology and Lecturer in Physiological Hygiene in the John Hopkins University at Baltimore. Professor Lee was born in England and educated in Queensland. After graduating in Science he proceeded to medical courses at Sydney, where he graduated with the University Medal in 1929. While at the University College, London, and the Fatigue Laboratory of Harvard University, he won the Sharpey Scholarship for 1934-35 and the Schafer Prize for 1935. In 1936 he was appointed to the Chair of Physiology at the King Edward VII College of Medicine, Singapore, but he resigned to accept the position of head of the Sir William MacGregor School of Physiology, on the foundation of a Medical School in the University of Queensland in 1936.

Under Professor Lee's direction, the School has pursued three main lines of research: laboratory and field studies of the reactions of man and animals to climatic stresses; application of knowledge so gained to problems of settlement and community development; and fundamental systematic investigation of the evolutionary development of heat regulation in the vertebrates. During the war period, Professor Lee was a member of the Directorate of Research and of the Physiological Research Committee of the military force, and a member of the Flying Personnel Research Committee of the air force. During his tenure of the Chair of Physiology, some fifty research papers have been published from the Sir William MacGregor School.

Longevity in Australian Science

At the annual dinner of the Royal Society of New South Wales, the President called attention to the fact that the eight living members of the Society who have attained fifty years of membership are grouped as follows. The year indicates the date of admission.

Physicians and Surgeons
1879 Joseph Foreman
1893 Cecil Purser
1896 Roland James Pope
1898 Walter F. Burfitt

Civil Engineers and Surveyors
1890 Henry Harvey Dare
1891 R. T. McKay
1892 Henry F. Halloran
1898 Frank Lee Alexander

Out of more than five hundred who were admitted as members during the period 1879-1898, there are no survivors from any of the other disciplines of learning. They had included many judges, clergy, educationists, journalists, authors, artists, astronomers, mathematicians, physicists, chemists, geologists, biologists, graziers and a Professor of Greek.

Personal

Miss Helen Newton Turner, of the McMaster Animal Health Laboratory, Sydney (C.S.I.R. Division of Animal Health and Production) is leaving Australia in June to spend six months abroad. She will attend the International Conferences of the Biometrics Society and of the Institute of Statistics, which will be held in Switzerland in September.

Mr. H. J. Frost, Superintending Physicist of Defence Research Laboratories, Ascot Vale, left by the *Orcades* in February on a twelve months' visit to the United Kingdom, Canada, and the United States of America, to study current overseas developments in physics and related sciences. He is to visit government establishments, university laboratories, and laboratories of Research Associations and private firms in Great Britain. He will also visit the Philips works in Holland; the works of La Société Genevoise d'Instruments de Physique, and of Alfred J. Amsler and Sons, in Switzerland; the National Research Laboratories in Canada; and the National Bureau of Standards in the United States.

Professor J. Neil Greenwood has been awarded a Nuffield Foundation travelling fellowship and has left for England and Europe, where he will visit metallurgical laboratories and study extraction techniques. Dr. Raymond Priestley, Vice-Chancellor of the University of Birmingham and formerly Vice-Chancellor of the University of Melbourne, has been created a Knight Bachelor. Professor Worner, who was recently elected a Fellow of the Australian Chemical Institute as a metallurgist, has been elected to the Fellowship of the Institution of Metallurgists, London. G. K. Batchelor (formerly of Melbourne), Aitchison Travelling Scholar and Fellow of Trinity College, Cambridge, has been appointed lecturer in Mathematics in Cambridge. Dr. F. L. Stillwell, who is in charge of mineragraphic investigation for the C.S.I.R., has been awarded the Medal of the Australasian Institute of Mining and Metallurgy.

Professor L. S. P. Davidson, of the Chair of Clinical Medicine in the University of Edinburgh, recently visited Melbourne by arrangement with the local Medical Post-Graduate Committee to deliver two lectures and to visit hospitals and the University. Professor Davidson is an authority on diseases of the blood and the anaemias. Dr. M. F. R. Mulcahy, who was awarded a C.S.I.R. studentship last year, has returned to Australia after having graduated Doctor of Philosophy at Oxford. Professor G. W. Pickering, of St. Mary's Hospital, London, is visiting Melbourne as Sims Travelling Professor.

The degree of Doctor of Science has been conferred by the University of London upon Dr. Allan Walkley, who graduated from the University of Adelaide and later worked at Cambridge and the Rothamsted Experiment Station. His published work deals with research on the chemistry of soils and nutrition of plants, especally trace-element nutrition, within the Division of Soils and Industrial Chemistry of the C.S.I.R.

The Court of the Goldsmith's Company, London, has awarded a scholarship, to undertake research in metal physics in Australia, to Trevor Broom, a Cambridge graduate who has been working on copper-nickel-iron alloys with the British Non-Ferrous Metals Research Association. Mr. Broom has been accepted as guest research worker in the C.S.I.R. Division of Tribophysics in Melbourne.

P. G. Law, formerly lecturer in Physics in the University of Melbourne, has been appointed Head of the Antarctic Division of the Department of External Affairs. C. E. Palmer, formerly senior lecturer in General Science in the University of Melbourne, has been appointed consultant in meteorological matters to the United States Air Force in the Northern Pacific Area. Dr. Lorna Sisely has been awarded the Gordon Craig travelling scholarship by the Royal Australasian College of Physicians, for post-graduate study abroad; she is the first woman to be awarded the scholarship. Dr. E. R. Love, who has been spending a year's leave in taking up residence as a Fellow at Trinity College, Cambridge, and has attended the International Congress of Applied Mathematics in London, will return in June to his position as senior lecturer in Mathematics in the University of Melbourne.

The Scientific Societies

Royal Society of New South Wales

April (annual meeting): R. L. Aston, Presidential Address, National surveying in Australia.
- P. B. Andrews, A contribution on the stratigraphy and physiography of the Gloucester District, N.S.W.
- R. C. L. Bosworth, The effect of diffusional processes on the rate of corrosion.
- R. C. L. Bosworth, The influence of forced convection on the process of corrosion.
- R. C. L. Bosworth, The influence of natural convection on the process of corrosion.
- R. C. L. Bosworth, The formation of oxygen on tungsten films.
- R. C. L. Bosworth, A note on the Sigma phenomenon.
- H. H. G. McKern, A note on the essential oil of *Backhousia anisata* Vickery and the occurrence of anethole.
- G. E. Mapstone, Nitrogen in oil shale and shale oil. VIII, The detection of tar bases; IX, Density-temperature relationships of shale tar bases.
- W. H. Robertson, Occultations observed at Sydney Observatory during 1948.
- B. Breyer and F. Gutman, Processes in dielectrics containing free charges: The entropy of electrostatic systems.

Royal Society of Queensland

March (annual meeting): H. C. Webster (Presidential Address), Energy and the future of mankind.

Royal Society of Victoria

March (annual meeting): P. W. Crohn, The geology, physiography and petrology of the Omeo District, Victoria.

Medical Sciences Club of South Australia

March (annual meeting): W. R. Adey, The nervous system of the local Australian giant earthworm.

Victorian Society of Pathology and Experimental Medicine

April: E. S. J. King, Spread of carcinoma of lung.
- F. B. Byrom, Acute cerebral complications in the hypertensive rat.
- A. Gottschalk and P. E. Lind, Characterization of the influenza virus enzyme as a hexosaminidase.

Office Bearers for 1949

Royal Society of Victoria

President, Harley Wood; Vice-Presidents, R. L. Aston, H. O. Fletcher, D. P. Mellor, F. R. Morrison; Secretaries, R. C. L. Bosworth, W. B. Smith-White; Treasurer, A. Bolliger; Councillors, Ida A. Brown, R. O. Chalmers, F. P. J. Dwyer, F. N. Hanlon, R. J. W. Le Fevre, C. J. Magee, C. St. J. Mulholland, D. J. K. O'Connell, O. U. Vonwiller, N. R. Wyndham.

Royal Society of Victoria

President, P. Crosbie Morrison; Vice-Presidents, J. S. Turner, F. L. Stillwell; Treasurer, R. T. M. Prescott; Librarian, F. A. Cudmore; Secretary, C. M. Tattam; Councillors, D. A. Casey, J. K. Davis, E. S. Hills, L. H. Martin, W. A. Osborne, H. S. Summers, O. W. Tiegs.

Victorian Society of Pathology and Experimental Medicine

President, S. D. Rubbo; Secretary, I. J. Wood; Treasurer, Hildred Butler; Committee, Edgar North, P. Fantl.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

Amino Acids in Tobacco Mosaic Virus

Early analyses by Ross (1942) indicated that glycine, histidine, methionine and lysine were not constituents of tobacco mosaic virus. Previously Ross (1941) had suggested that hydroxyproline was present.

Knight (1942), on the basis of chemical evidence, suspected that the virus might contain lysine and this was later shown to be the case by Stokes, Gunness, Dwyer and Caswell (1945), who used microbiological assay. The latter authors reported also that methionine and histidine were absent. Microbiological assay in the hands of Knight (1947) not only confirmed these results but provided an almost complete amino acid analysis of the virus. In particular, glycine and lysine were shown to be present and Knight confirmed the presence

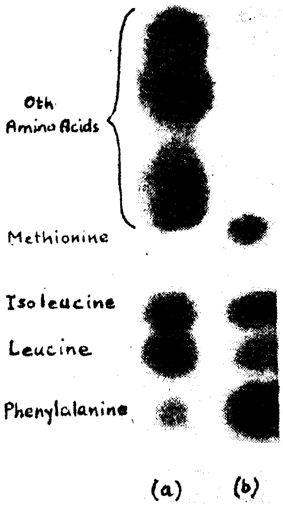

Figure 1.
One-dimensional chromatogram using tertiary amyl alcohol as the mobile phase. (*a*) Virus hydrolysate. (*b*) Control.

of glycine by one-dimensional paper chromatography. He does not report analyses of hydroxyproline.

Microbiological estimations have recently been subjected to some criticism by Rydon (1948) and Tristram (1948) and a serious difference between the estimates of the isoleucine content of edestin by microbiological and infra-red absorption methods exists (Darmon, *et al.*, 1948). Independently, in this laboratory, results similar to those of Knight had been obtained by one- and two-dimensional paper chromatography and it was thought that in view of the above criticisms these analyses of the virus from another source should also be recorded. The tobacco mosaic virus used was taken from a batch prepared by Best (1940) and hydrolysed for twenty-four hours in 6N hydrochloric acid at 100 degrees. After the removal of the free HCl and humin, aliquots were chromatographed in the usual way.

Figure 1 shows the chromatogram developed by a method due to Work (private communication), i.e., with tertiary amyl-alcohol in an atmosphere containing diethylamine. The solvent was allowed to drip off the bottom of the paper for five days. The chromatogram shows that iso-leucine, leucine and phenylalanine are constituents of the virus, but that methionine is absent.

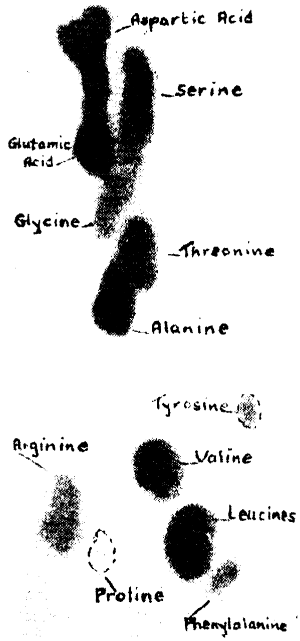

Figure 2.
Two-dimensional chromatogram using phenol and collidine/lutidine as the mobile phases.

For the main bulk of the amino acids the two-dimensional methods of Consden, Gordon and Martin (1944) were applied. For the first run phenol was used in an atmosphere of coal gas containing ammonia, and for the second collidine/lutidine (50/50) in an atmosphere containing di-ethylamine. The chromatogram (Figure 2) shows that hydroxyproline and histidine are absent. Being present in small amounts only, lysine and cysteine (as cysteic acid) did not show up on this particular chromatogram, but were evident when a more concentrated hydrolysate was used. Cystine was not detected on any of the chromatograms, but it cannot be said with certainty that it is absent, as it usually decomposes during two-dimensional chromatography (Dent, 1947) and often appears as cysteic acid. Methionine was also shown to be absent by a two-dimensional chromatogram in which the solvents were collidine and benzyl/butyl alcohols (50/50). The amino acids shown to be present and those shown to be absent are given in the following table:

Amino Acids Present		*Amino Acids Absent*
Alanine	Lysine	Histidine
Arginine	Phenylalanine	Hydroxyproline
Aspartic Acid	Proline	Methionine
Cyst(e)ine	Serine	
Glutamic Acid	Threonine	
Glycine	Tyrosine	
Iso-leucine	Valine	
Leucine		

Summarizing, the results of the application of paper chromatography are in complete agreement with the microbiological assay data. In addition, however, it has been shown that hydroxyproline is not a constituent of the tobacco mosaic virus.

F. J. R. HIRD.

Department of Biochemistry,
The University of Melbourne.
4 December 1948.

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An Accurate Determination of the 'Absorption/Relative-Humidity' Relationships of Silica Gel and Alumina

The need for a means of maintaining optical and other service equipment free from condensation and fungal growth has necessitated an investigation of the properties of a number of desiccants used 'statically'; these include the activated forms of silica gel and alumina, which, because they may be readily contained in their absorbed states, are particularly suited for enclosure in mobile equipment. A property of particular interest for desiccants used in this manner is their water content under varied conditions of humidity. The wide divergence of the results appearing in the literature regarding this property of silica gel and alumina has led to experiments, which have enabled a more accurate determination of the absorption*/relative-humidity relationships of these agents.

The method involves the measurement, under controlled temperature, of the vapour pressure in equilibrium with a specimen of the agent over a complete range of absorptions. Measurements are made at absorptions of decreasing magnitude, produced by a device that permits the removal of water in the required increments from the initially saturated desiccant. The mass of water absorbed is determined, in each case, by weighing the apparatus, which is designed so that its mass may be determined both accurately and conveniently.

The essential features of the apparatus are shown in Figure 1. The specimen is contained in the bulb A and is activated, in the absence of air, by continued evacuation at the required temperature. The water is outgassed by evacuation in the bulb B and is added to the desiccant through the tap C. The subsidiary apparatus used for preparing the water is then drawn off at D, so that the bulb containing the specimen may be completely enclosed in a

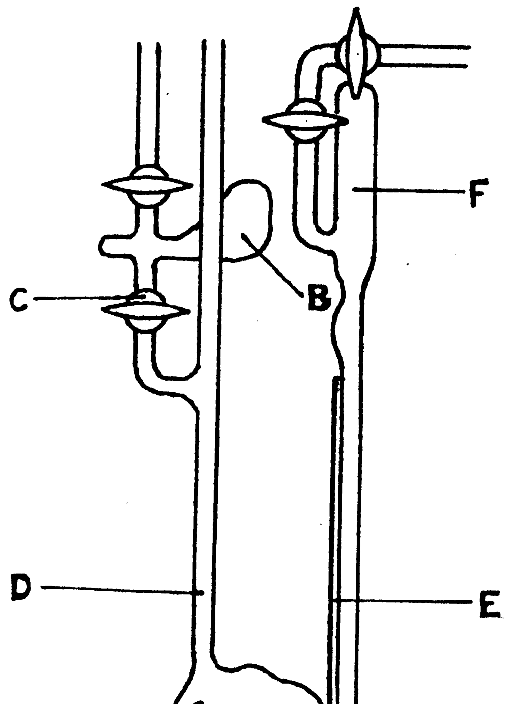

Figure 1.

thermostatically controlled bath. The equilibrium vapour pressure is measured on the manometer E, the outer arm of which is maintained evacuated. Both the manometer and the bulb containing the specimen are shaped to minimize pressure gradients and permit a rapid attainment of the equilibrium condition. Pressure readings are corrected for meniscus heights and are made against a finely divided opal glass scale, viewed from outside the bath with a travelling microscope. The outer arm of the manometer is made of large bore to reduce sticking of the mercury, errors due to which determine the ultimate limit to the accuracy of the method. To prevent the need

* The word 'absorption' is used in its broadest sense and is taken to include the process of adsorption.

for replacing B for each absorption, the bulb F is attached to the manometer and is used to permit the reduction of the water content of the desiccant. With the apparatus tilted on its side the mercury from the manometer lies in

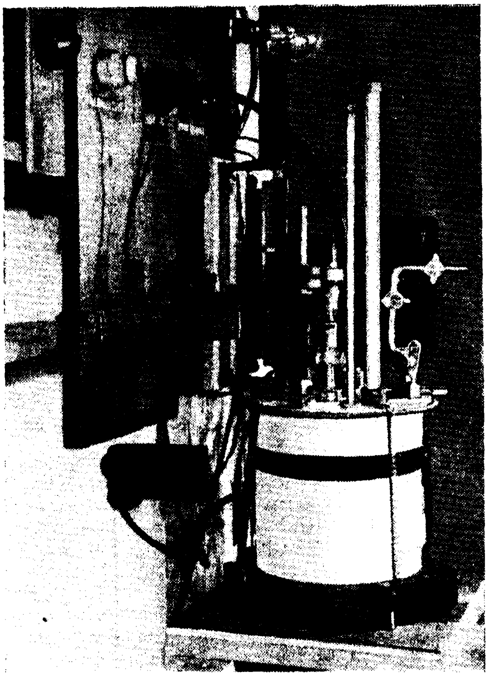

Figure 2.

F and the required amount of water may be removed from the desiccant by pumping. In the first instance, water is added in excess of that necessary completely to absorb the specimen. Subsequent pumpings enable the equilibrium relative humidity to be measured at the required increments over the complete absorption range. To ensure that all equilibrium points are 'absorption' points, as distinct from 'evaporation' points, the agent is allowed to approach equilibrium at a temperature below that at which the relationship is to be determined; the temperature is then raised to the required value. Correction for the mass of water vapour contained in equilibrium with the specimen is made throughout the experiment.

Figure 2 shows the apparatus in position in the bath, the temperature of which is maintained constant within 0·01° C. over the range 5° C. to 60° C. The latter is the maximum temperature at which measurement of the saturated vapour pressure is possible with the present length of apparatus. For the production of the higher temperatures, the bath is heated by internal elements. Temperatures below that of the room are obtained by using a thermostatically controlled pump to circulate in the bath a mixture of water and glycerine, cooled in a tower by the application of a freezing mixture.

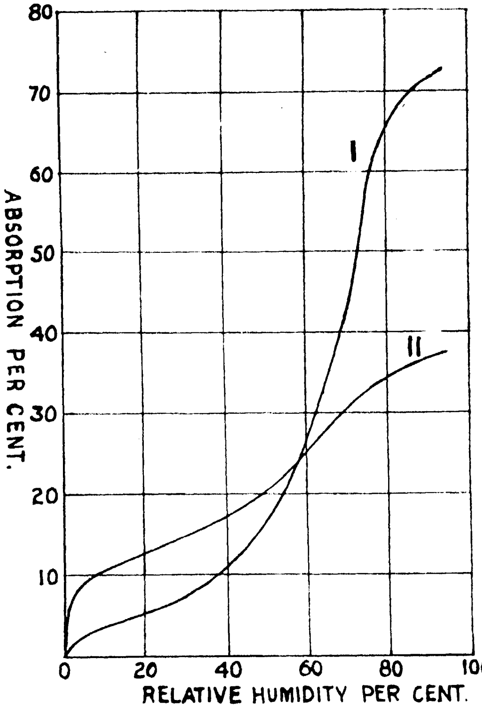

Figure 3.

The curves obtained relating relative humidity and the absorption of typical specimens of silica gel and alumina at 35° C. are shown in Figure 3. The most reliable results appearing in the literature regarding this property of silica gel are possibly those of Anderson (1914). Curve I is of the same general form as that obtained by Anderson. The quantitative disagreement of his results and the above results, however, indicates that the modern gels have a considerably greater capacity. Little precise information is to be found regarding the absorption properties of alumina, which until recently has been used much less extensively as a desiccant than has silica gel. The important features illustrated regarding alumina are that its absorption/relative-humidity curve is similar in form to that of silica gel and that at low humidities its water content is greater than that of this agent. At high humidities silica gel has the larger capacity. Determinations at other temperatures within the range 5° C. to 60° C. show the curves for both agents to be approximately independent of the temperature. This is in accordance with the findings of other workers on the absorption properties of hygroscopic materials in general (Masson and Richards, 1906; Trouton and Pool, 1905).

The experiments described are extendible to other desiccants.

G. A. Harle.

Department of Physics,
University of Sydney.
30 November 1948.

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Control of Mistletoe

The mistletoe, *Loranthus* spp., is a cause of serious disfigurement to many Australian trees. Where infestation is heavy, trees may be killed, or at least suffer severe loss of vitality. The damage is particularly noticeable along highways, or in cleared or partly cleared areas, such as water catchments or natural park lands: in these locations there seems to be some evidence that the damage is increasing from year to year.

The only known method of control at present is by lopping out infested branches. Because of the widespread distribution of the pest, however, this method is both cumbersome and expensive. A more efficient method of dealing with the problem is eagerly sought.

The writer has recently had some success from spraying mistletoe with hormone-weedicide sprays of the 2:4D type. An interesting feature has been the fact that, at the concentration employed, the host trees, *Eucalyptus* spp., have suffered no apparent damage, while the mistletoes have browned and withered within three weeks. This work is being extended and a full report on the chemicals used, methods of application, and so on, will be published elsewhere at a later date.

D. Hartigan.

Division of Wood Technology,
Forestry Commission of N.S.W.
8 February 1949.

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The Paper Chromatography of Inorganic Anions

The use of paper partition chromatography for the separation of mixtures of CNS^-, I^-, Br^- and Cl^- has been described in an earlier paper (Lederer, 1949). In the present communication the behaviour of a large number of the common anions will be described. The solvent employed in this investigation is butanol saturated with aqueous 1·5N-NH_4OH. This solvent was found to be satisfactory for the separation of halides (Lederer, 1949) and was therefore selected, firstly to determine its suitability for the separation of other anions, and secondly to determine whether other anions would interfere with the separation of the halides. The technique employed here is the ascending development for twenty-four hours as described by Williams and Kirby (1948). The reagents used to detect the anions were sprayed on the paper with an Agla atomizer after drying for fifteen minutes. The Table gives the R_f values, reagents and reactions of the anions examined.

Anions	R_f Value	Reagent	Colour of Spot
Thiocyanate ..	0·45	$Fe(NO_3)_3$	Red
Iodide	0·30	3% H_2O_2	Blue
Nitrate ..	0·24	Univ. Indicator	Red
Arsenite ..	0·21	$AgNO_3/NH_3$	Yellow
Nitrite ..	0·20	KI and HCl	Red
Bromide ..	0·16	$AgNO_3$ wash/H_2S	Black
Bromate ..	0·13	KI and HCl	Red
Chloride ..	0·10	$AgNO_3$ wash/H_2S	Black
Iodate	0·03	KI and HCl	Red
Fluoride ..	0·0	$Fe(CNS)_3$	White
Sulphide ..	0·0	$AgNO_3$	Black
Thiosulphate	0·0	Dilute I_2	White
Sulphate ..	0·0	Univ. Indicator	Red
Periodate ..	0·0	KI and HCl	Red
Chromate ..	0·0	——	Yellow
Oxalate ..	0·0	Univ. Indicator	Red
Phosphate ..	0·0	$AgNO_3/NH_3$	Yellow
Arsenate ..	0·0	$AgNO_3/NH_3$	Brown
Ferricyanide ..	0·0	Ferrous sulphate	Blue
Ferrocyanide ..	0·0	Ferric sulphate	Blue
Picrate	0·7	——	Yellow

All monovalent ions, with the exception of periodate, travel with the solvent, and all multivalent ions, with the exception of arsenite, do not move with the solvent. The reagent employed for locating sulphate, nitrate and oxalate was universal indicator, because of lack of more specific reagents: until such reagents are developed, paper chromatography seems to be unsuitable for the detection of these ions in mixtures. The method is very suitable for the detection and separation of the following ions and mixtures:

(a) the separation of halides in presence of most other ions;
(b) the separation of nitrite from bromate, iodate and periodate, enabling its detection by the use of acidified potassium iodide;
(c) the separation of most monovalent anions from mixtures with multivalent anions.

The separations were carried out with potassium, ammonium and sodium salts of the anions, since such can be readily obtained by boiling the substance under examination with aqueous sodium carbonate solution.

Picrate and oxalate were included because they are commonly used in conjunction with inorganic substances. No experiments were undertaken with salts of volatile acids, such as cyanide and sulphite, since they would volatilize in a weakly ammoniacal solution. Further experiments with different solvents and organic acids are in progress.

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Sydney.
15 February 1949.

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Pentoses in Hair

It has been shown previously that aqueous extracts of hair contain glycogen (Bolliger and McDonald, 1947 and 1948) and directly reducing substances (Bolliger and McDonald, 1948). The nature of these directly reducing substances was not previously clear, but in a number of eutherian mammals they have now been found to contain pentoses in varying amounts as demonstrated by positive orcinol, phloroglucinol, benzidine and negative fermentation reactions. Quantitative estimations using the colorimetric method of McRary and Slattery (1945) have been carried out, and it has been found that the amount of pentose contained in hair varies from 30 mgm. per cent. in man to 200 mgm. per cent. in the rabbit. The results, including those for total directly reducing substances (Somogyi, 1926) expressed as glucose, are shown in the Table. They represent the mean values of a number of determinations on different animals.

PENTOSE AND DIRECTLY REDUCING SUBSTANCES PRESENT IN VARIOUS ANIMAL FURS

Fur from	Reducing substances[1] mgm%	Pentose mgm%
Rabbit (albino) ..	230	200
Rat (albino)	130	60
Human	80	30
Cat	250	Positive[2]
Sheep[3]	200	50
Phalanger (dorsal)	250	Negative
,, (ventral)	900	Negative

[1] Expressed as glucose.
[2] Solution too turbid for accurate estimation.
[3] Corriedale wool defatted with ether.

In the rabbit, the amounts of directly reducing substances and pentose were found to be approximately identical, whilst in man and the rat about half of the directly reducing substances could be accounted for as pentose, and in defatted sheepswool only one quarter of the total reducing substances could be identified as pentose.

The nature of the pentoses in fur has not yet been determined with certainty. They are assumed to be derived, however, from nucleic acid, in analogy with the purines also found in the aqueous extract of hair (Bolliger and Hardy, 1945; Bolliger, 1949). This assumption would suggest that the pentoses in hair may be ribose, a hypothesis supported by paper-chromatographic findings.

In contrast to the eutheria examined, *Trichosurus vulpecula*, the common Australian phalanger or 'possum', the only marsupial so far tested, was found not to possess water-soluble pentoses in its fur, in spite of the large amounts of directly reducing substances present.

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21 March 1949.

* Working under a grant from the National Health and Medical Research Council.

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Reviews

Agriculture

FARM SOILS: THEIR MANAGEMENT AND FERTILIZATION, 4th edition. By Edmund L. Worthen. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 510 pp., 200 photos and text figs., 57 tables. 5½" × 8".) Price, $3.20.

This book, one of the Wiley Farm Series, is by a Professor Emeritus of Soil Technology of Cornell University and is written for farmers and for such students as are interested primarily in the problem of practical soil management. The first edition appeared in 1927 and the author and editors claim, with justification, that they have not been afraid to advocate changes in recommended soil-management practices, based on new information resulting from recent research. The setting of the book is essentially that of the eastern United States and much of the illustrative material used is based on experimental work in the States of New York, Illinois and Ohio.

The pattern of the book is that each chapter deals first of all with the practical operations concerned in soil management and crop growing; this is followed by a section of general information dealing either with the scientific background or with the more technical details concerned with the practical aspects that have just been covered. Each chapter then concludes with suggestions for community studies and with a few arithmetical problems. These community studies can be recommended to district agricultural advisers in Australia and to local extension groups and agricultural bureaux, as affording examples and suggestions for the organization of field days in this country.

The general information in the early chapters attempts to supply enough chemistry and plant physiology to serve the needs of the reader throughout the book and perhaps suffers, particularly with respect to soil science, from the successive revisions that have been necessary since the first edition in 1927. The book deals with the drainage of soils, the control of soil erosion, tillage, the use of farmyard manure, lime and chemical fertilizers, crop rotations and the management of the soils of pastures, lawns, gardens and orchards.

An Australian reader will note particularly the emphasis placed on the regular use of

farmyard manure and of lime, and the great emphasis placed on mixed fertilizers in the range of American field husbandry covered by the author. An Australian farmer reading the book will find himself in most cases in an unfamiliar environment, but it can be recommended to the University and College teacher in agricultural science and to those students and agricultural advisers interested in the contrasts and parallels between North American and Australian conditions. The reader should find it a useful discipline to interpret the recommendations of the book to Australian farmers from the common fund of general information.

J. A. PRESCOTT.

SVALÖF, 1886-1946. History and Present Problems. Edited by Å. Åkerman, O. Tedin and K. Fröier. English Technical Editor, R. O. Whyte. (Lund: Carl Bloms Boktryckeri A-B, 1948. 389 pp., 9″ × 6″.) English price, 30*s*.

Plant breeding in Europe owes a tremendous debt to the Swedish station at Svalöf which was founded in 1886. Plant breeders throughout the world are familiar with the term 'Svalöf method' which is used to designate certain practices which were evolved there. Now the editors make available a valuable account covering the sixty years' work at this famous centre. Delay in its appearance is due to World War II.

Plant breeding is dealt with under Swedish conditions; so a general account of the climate and soils, illustrated by suitable maps, is given at the outset. Then some twenty different authorities at the Institute describe their work. Some of the contributions deal with historical data and organization, incorporating the experience gained over a period of years; others specialize on their particular crop; whilst others again deal with the underlying principles that are involved in plant improvement. Each author is a specialist in his subject and, within the relatively small compass allotted, summarizes his matter in a very adequate fashion. Excellent illustrations are given. Bibliographies are included after various sections, covering the work done in them.

Whilst the cereal work, and particularly that dealing with oats, has long been fully recognized by breeders, the Svalöf activities with such a range of crops as hemp, hops, lupins, maize, rubber, dandelion, and tobacco, have had little publicity. These crops are not of the same intrinsic value to Sweden as, say, cereals or roots; but thoroughness in the treatment of improvement problems by modern methods characterizes this work. The over-all impression given is that at Svalöf we have a living, pulsating institute where plant breeding is being tackled in the best ways known and where results of outstanding value are achieved.

The get-up of the book leaves nothing to be desired. As a reference book it will serve a most useful purpose. It is to be hoped that the wish expressed in the Preface will be realized: that the book will result in an intensification of the international relations of the Svalöf institute.

W. L. WATERHOUSE.

Biochemistry

ADVANCES IN PROTEIN CHEMISTRY, Volume IV. Edited by M. L. Anson and John T. Edsall. (New York: Academic Press Inc., 1948. 575 + ix pp., numerous text figs. and tables. 6¼″ × 9″.) Price, $8.50.

Five of the eight articles of Volume IV of this series deal with various aspects of the structure, reactions and separation of proteins and their derivatives. The complex associations between fibrous protein molecules and solvents which result in the formation of gels is the subject of a long article by J. D. Ferry. Gels formed from gelatin, from various denatured proteins, and in the formation of fibrin from fibrinogen during the clotting of blood, are discussed in detail. The discussion of fibrin is limited to the properties and mode of formation of the gel and does not consider the enzyme system involved in the process.

The stereochemistry of the amino acids, and the X-ray analysis of these compounds and of the peptides formed from them, are discussed by A. Neuberger and R. B. Corey respectively. The structure of certain synthetic detergents, their quantitative reaction with purified protein, and their interaction with complex biological systems, as shown in their bactericidal and bacteriostatic action, are discussed by F. W. Putnam. The development of electrophoretic methods for the separation of proteins is discussed by H. Svennson, and the various types of apparatus are described.

J. Wyman contributes a comprehensive article on the haem proteins. The structure and wide distribution of these proteins are considered in both animals and plants. The similarity of the prosthetic groups of the wide range which occurs in these compounds is discussed, and the fact that their differences of behaviour are associated with the apo- portion of the molecule. The peculiar properties of the haemoglobins are dealt with at length. The reasons for the peculiar form of the saturation-pressure curves for the reversible compounds formed with various gases, especially oxygen, are discussed from the point of view of the structure of the molecule and the thermodynamics of the reaction. Special attention is given to the fact that reaction with oxygen does not lead to the oxidation of the iron of the haemoglobins as it does with the iron of other haem proteins. The article is a most useful review of present knowledge of this group of proteins, which plays such an important part in the respiratory processes of living organisms.

Among the more descriptive articles are those by A. M. Pappenheimer on the Proteins

of Pathogenic Bacteria, with special reference to haemolytic streptococci, Group A; and that by A. B. Gutman on the Plasma Proteins in Disease. The latter article collects much widely-scattered information on the fractionation of plasma proteins, their variation in specific diseases and the possible significance of these variations.

This volume maintains the high standard of its predecessors. It is excellently produced. In addition to the extensive bibliographies accompanying each article, there are comprehensive general author- and subject-indices.

H. S. Halcro Wardlaw.

Biology

General Biology, 3rd edition. By James Watt Mavor. (London and New York: MacMillan, 1947. 986 pp., numerous text figs. and photos. $6\frac{1}{4}'' \times 9\frac{1}{4}''$.) English price, £1 7*s.* 6*d.*

The author's aim, explained in his preface, is: 'To state simply and clearly the main facts and principles on which a sound and teachable course in biology can be based. This requires that the balance between the botanical and zoological portions be such as to provide for a real grounding in each of these subjects.' The aim has been realized in a book which can be strongly recommended to students studying biology, botany and zoology at first-year University standard, and to all those interested in the teaching of biology at any stage.

The book is divided into six parts. The first part, on the nature of life, includes chapters on fundamentals of chemistry and physics essential as an introduction to the study of protoplasm. The facts are vividly presented to the beginner and the chapters could be read as a valuable summary by all students of biology. The second part deals with plants; the third and fourth with animals, invertebrate and vertebrate. The fifth part treats of development and heredity; and the sixth, of the organic world and its evolution. An appendix gives a synopsis of the subdivisions of both plant and animal kingdoms. Phyla, classes and orders are briefly described and examples cited. Helpful suggestions for further reading are given at the end of each chapter. In addition to covering a wide syllabus in some detail, the author has included references to the history of discoveries in biology. He has also linked academic work with its practical applications; for example, in well-planned chapters on bacteria and on the economic importance of plants.

General Biology is based on Professor Mavor's course in biology at Union College, New York. The book was first published in 1936 and reprinted five times; a second edition was published in 1941. In the preparation of this third edition, the text has been revised throughout and the opportunity taken to add new material, particularly in the sections dealing with development and heredity, and on evolution. A short section of the statistical study of mutation and selection is a useful introduction to an important field of work—one which has hitherto been neglected in general textbooks.

The book is admirably produced; the type is attractive and easy to read. The subject matter is well arranged under sub-headings and a number of tables summarize details. The style is clear and direct, and interest is maintained throughout. Numerous excellent diagrams and photographs are a feature of the book: the diagrams are large, free from irrelevant detail, clearly labelled an admirably selected.

Winifred M. Curtis.

Chemistry

Dipole Moments. Second edition. By R. W. J. Le Fevre. (London: Methuen, Monographs on Physical Subjects, 1948. 117 pp., 23 text figs. $4'' \times 6\frac{3}{4}''$.) English price, 5*s.* net.

The first (1938) edition of Le Fevre's *Dipole Moments* gained the well-deserved reputation of being one of the best available introductions to the subject. The second (1948) edition, described by the publishers as having been 'revised and reset', is for the most part identical with the first, the most substantial revisions consisting of additional material dealing with methods of measurement in Chapter II, and several new examples of the application of dipole moments to problems of molecular structure in Chapter IV. Otherwise, minor changes and additions occur at intervals throughout the book; although it is unfortunate that the omission of arrows, showing resultant moment directions, from the diagram on p. 71 of the new edition, makes the discussion of the mesomeric effect on dipole moment a little obscure.

The author has succeeded in compressing a remarkable amount of material into 112 pages without sacrificing clarity or accuracy. Chapter I deals with the theory of dielectric polarization, including the Clausius-Mosotti relation and Debye's theory of orientation polarization. This is followed by the chapter on experimental methods for the measurement of dipole moments. Chapter III discusses the difficult problem of the effect of the solvent on solute dipoles, and includes statements without proof of a number of attempts to solve the problem, including that of Onsager. In view of the importance of the issues, it is a pity that this chapter could not have been expanded, although an adequate treatment probably could not have been given within the scope of a Methuen monograph. A number of examples, both organic and inorganic, to show the application of dipole moment measurements to structural problems, are presented in Chapter

IV., where the vector addition of moments as modified by the 'ortho', inductive, and mesomeric effects is discussed in some detail. Chapter V deals with intramolecular rotation and molecular flexibility, and Chapter VI with the interesting anomalous cases where apparently symmetrical molecules possess in solution a total polarization which is greater than the molecular refractivity, suggesting the presence of a permanent dipole moment.

Key references to the literature are appended to each chapter, and a useful table of dipole moments of the commoner inorganic and organic compounds is included. The book can be recommended as worthily fulfilling the aim of the Methuen monograph series to supply 'readers of average scientific attainment with a compact statement of the modern position in the subject'.

N. S. BAYLISS.

THE SYSTEMATIC IDENTIFICATION OF ORGANIC COMPOUNDS. Third edition. By Ralph L. Shriner and Reynold C. Fuson. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 370 pp., 22 text figs., 46 tables. 5½" × 8½".) Price, $4.00.

No mechanically applicable 'system' has yet been devised for Qualitative Organic Analysis. This is fortunate because, properly approached, such analysis can greatly increase a student's knowledge, improve his practical skill, and exercise his powers of observation and inference.

Nearly half a century has elapsed since the appearance of Mulliken's *Systematic Analytical Procedure based on Physical Properties and Chemical Reactions*. Clarke's *Handbook of Organic Analysis, Qualitative and Quantitative* has been in use for a not much shorter period. Shriner and Fuson's *Systematic Identification of Organic Compounds* is already a well established third member of an honourable trio.

The present book is a third edition. Its advice is on well tried lines. After preliminary examination of an 'unknown' for purity, there follows its assignment to a solubility class, and the application of 'classification reagents'. Emphasis is placed on physical properties as criteria. The preparation of derivatives is given full discussion.

For this edition one entire chapter—that on 'the solubility classes'—and several smaller sections, have been completely re-written. New 'classification reagents' are introduced. Many additions and changes have been made in the tables to physical constants, which, occupying sixty pages, are a valuable feature.

The work forms a handsome and well produced volume, which a student might well wish to possess for reference in later years. It is advertised in Australia at 28 shillings. This is a pity and may diminish its sales. In England it sells at 13 shillings.

R. J. W. LE FEVRE.

INTRODUCTION TO ORGANIC CHEMISTRY. Third edition. By Ira D. Garard. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 396 pp., numerous text figs. and tables. 6" × 9".) Price, $6.50.

A 1948, and third, edition of this book is now available in Australia. Originally produced some sixteen years ago, the work has evidently achieved popularity in the United States. Designed according to its preface, for 'introductory courses in organic chemistry which extend over just one semester', it is declared by its publishers, in their leaflet, to be a thought-provoking approach in which emphasis is placed on making the student think.

The literature of chemistry already contains so many 'introductory' text-books that, in adding one more, novelty of treatment must inevitably be a leading justification. Judging on this basis, the reviewer thinks the treatment somewhat disappointing. It is true that each chapter is followed by lists of questions, and references for further reading, but neither of these features is unusual. On the whole, the form is conventional.

A book of nearly 400 pages is not small, yet topics such as the Grignard reaction and the application of acetoacetic ester to synthesis are stated to have been selected for omission. Likewise there is scarcely any mention of physical properties *vis-à-vis* molecular structure, even the typically 'organic' subject of optical isomerism is given only brief attention. The 'discussion of polarized light . . . included to aid the student in understanding the rather difficult property of optical activity', which the preface specially mentions, consists of a few unhelpful lines about packs of cards. The 'nature of valency', also cited in the preface, turns out to be a most elementary explanation of covalency and electrovalency.

The style is not always elegant. Phrases occur such as 'The most universal chemical property of esters . . .', 'some hue of yellow or orange', '. . . coconut oil is a liquid in the tropics and a solid in a cool room. Only a few fats are in the retail trade . . .'

A good feature is the inclusion of directions for some thirty-two illustrative laboratory experiments together with lists of apparatus and chemicals required for them.

The price will be high in Australia. The reviewer compares the book unfavourably with Read's *Direct Entry to Organic Chemistry* which—at 7*s*. 6*d*. (Australian)—contains in its 268 pages a wider indication of the wealth of modern organic chemistry, set out in a manner which stimulates interest without losing succinctness, scientific accuracy—or euphony.

R. J. W. LE FEVRE.

OUTLINES OF PHYSICAL CHEMISTRY. By Farrington Daniels. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 713 pp., 164 text figs. 6" × 9".) Price, $5.00.

This is really a completely new edition of a

book entitled *Outlines of Theoretical Chemistry* written in 1913 by Dr. Frederick H. Getman, who revised it in three subsequent editions between 1918 and 1927. In 1930 Dr. Farrington Daniels undertook to re-write the book, and new editions appeared under his name and that of Dr. Getman. The present (1948) edition in Dr. Daniels's sole name is best described in the author's own words: 'The present work is regarded as the first edition of a new book, in which the author has attempted to meet his responsibilities for better presentation of physical chemistry by adding recent developments in the field, clarifying descriptions, eliminating some of the more elementary material, re-arranging chapters and transferring some of the more specialized parts to the appendix. He has tried to bring out fundamental principles and to give glimpses of the frontiers of physical chemistry . . . Many new problems have been substituted for old ones, thought-provoking problems being stressed rather than the formula-illustrating type.'

The work is attractively put together. The print is good, and the diagrams and illustrations excellent. The author does not go very deeply into any subject, and the book must be regarded as an introduction to, rather than a full exposition of, physical chemistry. The mathematics involved are relatively simple and no attempt is made to include anything more than the merest introduction to quantum or statistical mechanics. More advanced proofs are reserved for the appendix. There are a number of problems at the end of most chapters, but the answers to all of them have not been given.

The book may be recommended to those students who have just passed the elementary stage and wish to obtain a reasonably broad survey of the field of physical chemistry before entering one or other of the more specialized departments.

T. IREDALE.

ORGANIC CHLORINE COMPOUNDS. By E. H. Huntress. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 1443 pp. 5¾″ × 9″ × 2¼″.) Price, $27.50.

The unceasing growth of organic chemical records leads daily to ever greater difficulties in the systematic and orderly recording of the discovered facts in such a way that all the important data relevant to a desired compound or method can be located with the minimum loss of time and effort. Far more chemists are concerned with the discovery or synthesis of new compounds than with the systematization, classification and collation of the results they produce. Yet, immeasurable research time is saved by works of reference that expedite literature searches. One cannot imagine organic chemistry without its 'Beilstein'.

Even Beilstein is inadequate today, and we find a second great compendium complementary to, but of quite different character from Beilstein, appearing in Elsevier's *Encyclopaedia of Organic Chemistry*. Every organic researcher who draws upon these stupendous combined achievements in systematization blesses their authors for the time and effort saved to him, and clearly realizes the immense contribution they make to scientific progress.

In the new book now under review on *Organic Chlorine Compounds*, by Professor Huntress, we find still another great essay in systematization. In the space of over 1400 pages there is assembled a tremendous amount of information on 1320 selected organic compounds of order III—compounds containing carbon and chlorine; carbon, hydrogen and chlorine; or carbon, hydrogen, oxygen and chlorine. Unlike Beilstein, which aims at discussing all compounds, the present volume contains a selection. The author recognizes that any selection is bound to suffer criticism —and the reviewer was disappointed to find only passing reference to the α-isomer of 1:2:3:4:5:6:-hexachlorocyclohexane which has become an important insecticide very recently —but most organic chemists would agree in the main with the selections made. The documented information supplied on the compounds listed is, at times, staggering; it covers the preparation, properties, chemical behaviour and identification of the compounds under discussion. This is an expansion of the scheme adopted in the earlier work of Huntress and Mulliken, which dealt mainly with the identification only of pure compounds of Order I.

Even a cursory glance suffices to indicate the immense amount of work and scholarship that has gone into the preparation of this book. Wherever the compound selected is mentioned in Beilstein (*Hauptwerk bzw. Erganzungswerke*), the appropriate cross references are given. The list in the introduction shows that no less than 315 abbreviations are used! A glance at a few examples shows that the number of listed original literature references to monochloracetic acid (compound number 3:1370) is 626; to carbon tetrachloride (3:5100) is 523; to benzoyl chloride (3:6240) is 612; and to benzyl chloride (3:8535) is 629. These, of course, are very well known and much-worked-with compounds. There are others to which there is only a single reference. The total number of literature references is stated by the author to be 22,000, of which about two-thirds are to literature more recent than 1919.

In this work the author has adopted the principle of listing all of the relevant data on boiling points, melting points, densities and refractive indices; leaving it to the reader to interpret and choose. For example, no less than forty-seven different observed values are listed for the boiling point of carbon tetrachloride at different pressures, together with the appropriate references. There are listed sixteen values for the freezing point that have been recorded in the literature, twenty values for

the density at different temperatures and twenty-six values for the refractive index.

Although the documentation is carried to a degree which may suggest to organic chemists that the volume comprises a 'Beilstein', the author hastens to disclaim any such degree of completeness; but he does claim 'that for each compound selected a meticulous search of the literature to the end of 1945 has furnished the basis for appropriate selection and systematic grouping of the aspects to be treated'. References to patents are included and the book gives emphasis to industrial aspects—which should greatly enhance its value to many industrial laboratories.

A word might also be said about the indexing. The author clearly explains the system by which each compound discussed is given a number, and it is very easy to find the compound once its number is known. There are no less than five separate indexes—the usual alphabetical name index, an index of compounds by empirical formulae, an index by chemical types, and indexes by chlorine percentages and by molecular weights.

Professor Huntress has produced a reference book of very considerable value for the chemist who has occasion to handle organic chlorine compounds—a book which is a 'must' for the shelves of the modern organic chemical library and which will be well thumbed as more and more users get to know what a treasure-house of carefully collated information it is.

F. LIONS.

RHENIUM. By J. G. F. DRUCE. (Cambridge: University Press, 1948. 92 pp. 5½″ × 8½″.) English price, 10*s*. 6*d*. net.

This is the fifth and the longest monograph yet published on rhenium. Although it was not discovered until 1925, nearly four hundred communications have already appeared on the properties of the metal and of its compounds. One hundred and forty papers have been published since the publication of *Das Rhenium* by I. and W. Noddack in 1933, so that the latest work is a timely summary of the present state of knowledge of this interesting element. Like the Noddacks, to whom (with Berg) the credit for the discovery of the element is usually given, Druce was associated with one of the three almost simultaneous announcements of the detection of dvi-manganese, and has contributed twenty-one papers to the subject. The monograph is thus authoritative and critical.

After a short introduction, in which the history of the element is discussed, a description is given of the isolation of metallic rhenium, its chief physical and chemical properties and the methods of detection and estimation. The oxides of rhenium, of which no less than nine have been claimed to exist, are discussed in Chapter 3. Chapter 4 deals with the most important compound of the element—perrhenic acid and its salts. Subsequent chapters describe the halogen, oxyhalogen and carbonyl compounds and the sulphides, selenides and thio-salts. Finally, two small chapters deal with the industrial applications and the patents relating to the element.

At the end of each chapter the relevant references are listed, and at the end of the book a valuable chronological bibliography is included. In the preface, the author mentions that the history of rhenium emphasizes once again that progress in science is due to international effort—a truth that is undoubtedly substantiated by the nationalities represented in the bibliography.

The monograph is well set up, printed and indexed. No typographical errors were noticed by the reviewer.

F. P. DWYER.

FATTY ACIDS AND THEIR DERIVATIVES. By A. W. Ralston. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 986 pp., many text figs. and tables. 5½″ × 8¼″.) Price, $10.00.

One of the best methods for the teaching of systematic organic chemistry is that in which each separate group of important organic substances—alcohols, ethers, aldehydes, etc.—is separately considered in order, in such a way that the following questions are posed and answered: How can the substances of the group be obtained from natural sources or by synthesis? What are their important physical characteristics? What chemical reactions can they be made to undergo, and into what valuable products can they be transformed? What are the more important individual substances of the group, and why are they so important?

The author of this book of almost one thousand pages takes one of the great groups of aliphatic compounds—the fatty acids—and answers all of these questions in a most lucid, satisfying and authoritative way. Indeed, after careful study, one can best express one's feelings by altering a famous remark of Osler and saying with almost equal truth, 'Know the fatty acids in all their manifestations and all things aliphatic shall be added unto you'.

Of his book the author explains that it logically divides itself into two sections, the first embracing a description of the fatty acids, their occurrence in nature, their synthesis and their physical properties. The second is concerned with the synthesis, properties and uses of the various fatty acid derivatives. One important limitation should be noted—that, except where it has been necessary for completion of a series or for purposes of orientation, discussion of fatty acids containing fewer than six carbon atoms is brief. The general chemistry, natural occurrence, isolation and physical properties of fatty acids proper are dealt with very adequately in four chapters embracing about 300 pages. Another chapter of about ninety pages is devoted to the unsaturated ethylenic acids, whilst a further

chapter discusses acetylenic acids, hydroxy acids, keto acids, cyclic acids and dicarboxylic acids. The four hundred or so pages devoted to the derivatives of the fatty acids contain discussions of such varied substances as fatty acid esters, nitrogen-containing derivatives of the fatty acids, the alcohols, ethers, mercaptans, sulphides, sulphonates, anhydrides, acid chlorides, aldehydes, ketones and the hydrocarbons obtainable from fatty acids.

This book is an absolute wealth of accurate information. Although it contains innumerable tables, it is in no way a collection of statistics but, on the contrary, it is a wholly satisfying account of practically every aspect of the chemistry of the fatty acids and all the substances related to them, written in most readable form and adequately documented—there being over 5,000 literature references. Primarily, it is a book for organic chemists. Although there are discussions of the results of most of the modern physical chemical studies of the fatty acids, all this physical work is kept in its right perspective—as work of value only because it helps the organic chemist to a better understanding of his organic substances. In the opinion of the reviewer, no modern organic chemist can afford to be without 'Ralston' on his shelves.

F. LIONS.

Engineering

M.I.T. IN WORLD WAR II.—Q.E.D. By John Burchard. (New York: John Wiley and Sons; London: Chapman and Hall. 354 pp., illustrated with photographs. 6″ × 9″.) Price, $3.50.

This is an unusual type of book, as it is purely a history of the war activities of a single institution, its staff and alumni. The field covered is, however, such a wide and varied one that the author succeeds in giving an interesting account of the way in which civilian scientists in the U.S.A. were enabled to turn their talents so effectively to war-time problems.

The Massachusetts Institute of Technology is not a particularly large organization numerically—the student enrolment in 1939 was 3100—but, as it caters solely for students in engineering and allied sciences, the type of training given was particularly appropriate for the science of warfare. In addition, its staffing was on such a liberal scale—a total of 683 in 1939—that it was possible for quite a large number of the staff to give all or part of their time to special war jobs. They were so effective as nuclei that the staff had grown to 6000 by the end of the war. The brief descriptions of the activities of such men as Karl Compton, Vannevar Bush and Edward Bowles in high administrative posts, introduce many of the war's greatest scientific achievements; and also many of the ubiquitous groups of initials, such as O.S.R.D., O.F.S. and even W.P.B.

The work at M.I.T. itself serves to introduce, on a more technical basis, numerous projects of high importance to the successful prosecution of the war. The most spectacular of these was the Radiation Laboratory—the great centre of radar development—the staff of which rose from fifty persons in 1941 to 3900 at the end of the war; but other projects, such as Underwater Sound, Metallurgy, Food Technology, and Chemical Warfare, also became very important activities, whilst numerous smaller ones are mentioned. Special training of Service personnel became a feature of M.I.T.'s work.

Care has been taken to give due acknowledgement to British developments where these had an appreciable influence on the work. This book will be particularly interesting to the many Australian scientists and technical representatives of the Services who visited the U.S.A. during the war, as, in addition to reading of the M.I.T. activities with which they were familiar, they will learn of many others which were carried on in that same group of buildings. It should also be interesting reading to all who may be concerned with the application of science to warfare.

G. H. MUNRO.

FUNDAMENTALS OF ELECTRIC WAVES. Second edition. By Hugh Hildreth Skilling. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 245 pp., 82 text figs. 6″ × 9″.) Price, $4.00.

This book provides excellent reading for either the mathematician who wishes to study the application of theory to problems of wave propagation, or the engineer who seeks a better understanding of the theory. It is written primarily for the latter, and its presentation of the subject is so clear and concise, and so free from unnecessary complications, that it should have a special appeal for those students of electric wave phenomena who are not inclined to acquire a great deal of mathematical dexterity.

The book opens with a description of four hypothetical experiments, each leading to a simple law of electrostatics, expressed in mathematical form. This is followed by a simple treatment of elementary vector analysis, which is then applied to the laws of the electrostatic field. The theory is then extended to cover electric currents and the magnetic field.

At this stage, Maxwell's equations are painlessly added, and the remainder of the book shows the application of those equations, together with the theory developed earlier, to various practical problems of the propagation of waves. The author states in the preface that the reader need have no earlier acquaintance with electromagnetic theory or with vector analysis. It might almost be said that prior knowledge of these matters would be a disadvantage, as they are introduced so simply and illustrated so well, as to provide an admirable first introduction to them. In particular,

the author takes pains to present each concept of vector analysis with illustrations which help to form a physical idea of its significance.

The new edition contains a number of improvements, mainly in providing further material on wave guides and wave propagation. The Giorgi rationalized system of M.K.S. units is used throughout. The book is to be recommended to advanced students of electrical engineering. Its chapters are arranged in a logical sequence, and emphasis is given, both in the illustrations and the text, to those points which are normally most troublesome to the students. The material is well presented and contains a number of useful tables of units and formulae.

D. M. MYERS.

HYDRAULICS. 5th edition. By H. W. King, C. O. Wisler and J. G. Woodburn. (New York: John Wiley and Sons; London: Chapman and Hall. 351 pp., 149 text figs. 5½" × 8½".) Price, $4.00.

The purpose of the revision for the fifth edition is stated to be, firstly, to improve the clarity and general arrangement in the light of continued experience with classes in elementary hydraulics; secondly, to add problems illustrating the application of basic theory to certain fresh engineering problems; thirdly, to expand the text material to include new developments recently accepted as an integral part of hydraulic engineering. Besides the usual field of hydrostatics, weirs, nozzles, orifices, pipe flow and channel flow, the treatment deals with the variation of hydrostatic pressure with altitude in a compressible fluid, flow through gates and over dams, the analysis of flow in pipe networks, non-uniform flow in channels, the hydraulic jump, abrupt waves and sloping waves, the resistance to objects moving through fluids, water hammer, hydraulic similitude and dimensional analysis.

The result is a modern and generally satisfactory text, which should be of benefit to students of elementary hydraulics in technical colleges and universities. Explanation is full and clarity in general very good. The authors have approached the subject from an engineering point of view, which makes their treatment very suitable not only for students but for practising engineers who require a reference book on basic hydraulics.

J. R. ASHTON.

ELEMENTARY STEAM POWER ENGINEERING. Third edition. By Edgar MacNaughton. (New York: John Wiley and Sons; London: Chapman and Hall. 640 pp., 497 text figs. and photos. 9" × 6".) Price, $6.50.

This is the third edition of an engineering text-book in a style which has been regarded as traditional in America. In conformity with the title the treatment is elementary, but the subject matter covers the whole field of steam power engineering and is presented in a highly pictorial manner.

With such a presentation the book becomes largely a judicious summary of engineering practice in its field, and its principal merit is that it can be followed with little difficulty by a student of mechanical engineering who is still in an early stage of his course of study. To such a student it can provide interesting reading and practical examples of applications of the fundamental principles which he is studying.

Engineering practice is subject to continual alteration, not only by the introduction of new subjects and methods, but by changes in relative importance which make the problem of revision a particularly difficult one in such a text-book as this. The difficulty usually leads to a compromise which leaves too much emphasis on matters which have lost their old importance, and frequently introduces the new matter away from its proper place in the book. While there are some traces of such troubles as these in the volume under review, they are only minor ones and on the whole the revision has been well and successfully done.

The treatment of thermodynamics might be described as severely practical, consisting of instruction largely by worked example and the provision of problems for each chapter. This is perhaps licensed by the use of the word 'elementary' in the title, but it does not provide a good enough foundation for more advanced study.

W. H. H. GIBSON.

Food

ADVANCES IN FOOD RESEARCH, Volume I. Edited by E. M. Mrak and George F. Stewart. (New York: Academic Press, 1948. 459 pp., numerous tables and text figs. 6" × 9".) Price, $7.50.

The appearance of this volume, which it is intended to make the first of a series, will be welcome to all those concerned with the scientific study of food. The field of 'food research' broadly covers every aspect except the purely agricultural. (Conditions of production are, however, considered in relation to the other aspects.) It is defined in the foreword as 'that field of scientific investigation concerned with foods and their relationship to man'. The editors propose to review every phase of food research on a continuing basis, and are planning to cover the following fields: human nutrition, food acceptance, agriculture, microbiology and public health, biochemistry and histology, food technology and engineering, entomology and zoology. Reviews on the various commodities, e.g. cereals, fats and oils, meat, fish, dairy products, eggs, fruit and vegetables, will also be included. Most of these fields are represented in the reviews in Volume I.

On the whole, an excellent start has been made and many valuable reviews are presented. Particularly good reviews of major fields are 'The physiology and chemistry of *rigor mortis*,

with special reference to the ageing of beer' by E. C. Bate-Smith; 'Factors influencing the vitamin content of canned foods' by L. E. Clifcorn; and 'Nonenzymatic browning in fruit products' by Earl R. Stadtman. The reviews on dried whole eggs by H. D. Lightbody and H. L. Fevold, on poultry by Belle Low, on processed potatoes by A. F. Rose, and on pectin by G. L. Baker, provide useful summaries in their respective fields.

'The physiological basis of voluntary food intake' by Samuel Lepkovsky, and 'The influence of climate and fertilizer practices upon the vitamin and mineral content of vegetables' by G. F. Somers and K. C. Beeson, cover fields in which little fundamental progress has been made. However, the present state of knowledge is clearly indicated and the available data, which are quite extensive, are well presented. 'Microbial inhibition by food preservatives' by Orville Wyss is somewhat disappointing. There is a rather brief discussion of the mechanism of inhibition, but detailed information on actual and potential food preservatives is lacking.

This volume is of value to all who desire to keep abreast of advances in the scientific knowledge of food. It provides a valuable introduction to many fields.

F. E. HUELIN.

Genetics

INTRODUCTION TO GENETICS AND CYTOGENETICS. By Herbert P. Riley. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 596 pp., 154 text figs. and photographs. 5½" × 8½".) Price, $5.00.

The remarkable development of the science of genetics in the past two decades has given us a new understanding of the nature of heritable variations in living things, from bacteria to the higher plants and animals. It has given us some concept of the nature of organic evolution and it has important applications to sociology, psychology, medical and veterinary science and to plant and animal breeding. Therefore, the need for an up-to-date text-book presenting established principles has been felt acutely by teachers and all serious students of heredity.

Professor Riley's book meets this basic need. The author has wisely avoided the historical approach, for this imposes such a burden on students as to leave insufficient time for an appreciation of more recent advances. The earlier part of the text gives a remarkably clear cytological foundation with a really excellent picture of mitosis and meiosis, associated with sufficient data on inheritance of simple character differences and reproduction to show the relationship between chromosomes, genes and characters.

The review of gene action, as in pleitrophy and the penetrance and expressivity of single genes, shows the monofactorial nature of familiar examples of abnormal mental, physiological and physical conditions in man. Thus the student quickly appreciates the importance of genetics in human welfare. In the seven chapters dealing with what might be termed classical genetics, that part dealing with Mendelian ratios follows traditional lines. It is associated, however, with a clear exposition of the application of the theory of probability and the relation of genes to chromosomes.

The author devotes ten chapters to the nature and physiology of the genes, including a condensed review of current theories relating to quantitative inheritance, inbreeding and selection. Gene mutations, their nature, frequency and induction by radiation, and methods of detection, receive full treatment, justified when one realizes that they form the basis of genetic variation and evolution. The comprehensive review of multiple alleles, particularly that part dealing with blood-type inheritance in rabbits and the AB, MN and Rh series in human beings, will be found invaluable by students of animal genetics. In the section devoted to gene action, the author reviews the genetic aspects of differentiation in cell groups in form and function. Some changes occur early and affect a large part of the individual. Others occur later and produce localized effects. The data relating to the part played by hormones and enzymes in differentiation indicates the necessity for increased research in the field of physiological genetics with the tools of biochemistry, physics, cytology, embryology and genetics. In connexion with quantitative inheritance, it is clearly shown that the theory of polymery is inadequate to account for size inheritance in mammals and that a number of single genes have quite pronounced effects.

The last seven chapters of the text deal adequately with aberrant chromosome conditions and the effect these have on phenotypic characters, as well as their role in speciation and evolution. The emphasis in the early part of this book on normal chromosome and gene behaviour will provide the student with the necessary basic knowledge to comprehend readily the nature and significance in evolution of deficiencies, duplication of segments, inversion and translocation; also monosomes, trisomes, haploids and autopolypoids.

The chapter on determination of sex and intersexual conditions is inadequate as regards the higher animals in a book of such merit. One cannot agree with the claim that 'female birds contain in addition to normal ovaries a small rudimentary testis that normally remains dormant but springs into activity as soon as the ovary ceases to function', or 'that internal conditions may . . . completely reverse a certain sex pattern', or again, that the sex of the individual can be controlled by removal of the sex organs and the grafting of organs of the opposite sex.

The book ends with an excellent chapter dealing with the modern genetic concept of species and the part played by geographical,

ecological, seasonal and other isolating mechanisms as factors in evolution.

This book is really excellent and is written in clear, concise English, which students will appreciate. The reviewer proposes to adopt it at once as the text for his class in genetics and recommends it both to teachers and students as the most modern and satisfactory text on the basic principles of genetics.

G. F. Finlay.

Veterinary Science

Pregnancy Diagnosis Tests: A Review. By A. T. Cowie. Commonwealth Agricultural Bureaux Joint Publication, No. 13, 1948. (283 pp. Obtainable from C.A.B. Liaison Officer, 314 Albert Street, Melbourne, C.2.) Price, 18*s*. 9*d*.

This is a valuable addition to the reviews of scientific literature. The author has surveyed all of the important papers upon diagnosis of pregnancy in women and domestic animals, with the exception of those concerned with clinical methods for women. The bibliography is very extensive and occupies ninety-nine pages. A chapter on clinical methods summarizes those available to the veterinarian and recommends some of the more important papers for further study; but these may not be easily accessible to all in Australia. The remaining nine chapters deal with hormonal tests and enzymic and other biochemical tests of body fluids, as well as tests based on physiological and immunological phenomena and on physical investigations of body fluids and tissues.

The chief value of the book is its completeness as a reference, especially for scientists newly undertaking investigations, so that they can assure themselves that they have not overlooked important contributions in a literature that is now voluminous. A useful paragraph on definitions and terminology clarifies many difficulties encountered by the uninitiated. The general adoption of such terminology would render terms of the literature intelligible to non-specialists, who would otherwise require an intimate knowledge of the development and history of the subject.

The title of the book might more correctly have been *Pregnancy Diagnosis* or *Pregnancy Tests*. The printing and arrangement are adequate and the price is minimal for such a complete work. Its purchase is justified for all who are interested in any aspects of pregnancy diagnosis.

T. S. Gregory.

Australian Science Abstracts

Vol. 27, No. 4 of Australian Science Abstracts will appear together with No. 5, as a Supplement to the next issue of this Journal, on 21 June, 1949.

The Australian Journal of Science

VOL. XI 21 June, 1949 No. 6

The Pacific Science Congress

Preliminary Report

A. P. Elkin

The Seventh Pacific Science Congress was held in New Zealand; the first Session in Auckland, February 2 to 8; the second Session in Christchurch, February 16 to 22; Mid-Sessional and Post-Sessional Tours were arranged. About two hundred scientists attended in addition to those from New Zealand; the Australian group consisted of nine official delegates, fourteen accredited members and one guest. The Commonwealth Government made a grant of £500 towards the expenses of the Australian National Research Council delegates; the Council for Scientific and Industrial Research and Government Departments were well represented. The Australian team was regarded as a strong one.

Organization

The only permanent element in the organization of the Pacific Science Congress is the Pacific Science Council. This consists of one representative from the national scientific institutions in each of the Pacific countries and territories which make up the Pacific Science Association, as determined by the Council in past years. The constitutional framework in which the Congress functions is simple. The host country is responsible for the conduct of the particular Congress, held by invitation of its Government and of its representative scientific institution. It must, however, orientate the Meeting towards the fundamental aim: to promote co-operation in the study of scientific problems relating to the Pacific region, more particularly those affecting the prosperity and well-being of Pacific peoples. In addition, when the Meeting is over, the Congress Committee of the host country is responsible for passing the recommendations of its Congress on to the representative institutions for implementation.

The Permanent Council gives advice and help to each host country; during the Meeting it sits regularly, under the chairmanship of the President of the Congress which is being held. It deals with suggested constitutional amendments, and examines resolutions and recommendations for research projects with a view to their submission to the full Congress. At the New Zealand Congress, the Pacific Science Council, in full or in committees, and including the adjourned meetings, met eight times. One special matter was the consideration of a proposal from Hawaii to amend the Constitution so as to allow of the appointment of a Permanent Secretariat to assist with the implementation of Congress recommendations, to assist planning committees, to provide a depository for Congress archives, and to be a means of liaison with the various research organizations in and around the Pacific. The Council accepted the Amendment, but ensured that the freedom of the host country in running each Congress would not be hindered in any way, and that the Congress would not be jeopardized if the Secretariat did not materialize; also, that the cost should not fall on the member countries. The Council set up two committees to see whether money and personnel would be forthcoming.

The Working of the Congress

The Congress did a very definite piece of work. By forming Research Planning Committees for each Division and also an over-all Planning Committee which reported to the Council, a valuable scheme of scientific research for the Pacific region was drawn up and accepted. The work of its Committees was helped by the symposium plan into which most of the papers and discussions of the Divisions fitted. Gaps in knowledge were indicated, urgent needs for research emphasized, and general principles enunciated by way of preambles. These research plans will be sent to the representative scientific institutions which form the Pacific Science Associa-

tion and through them to the Governments and other scientific bodies concerned. In the case of Australia, it will be the task of the Australian National Research Council to examine these plans carefully and to exercise its influence to see that effect is given to whatever the A.N.R.C. judges to be of importance to Australia or whatever it considers to be a responsibility of Australia.

In addition to the research planned, special Resolutions were approved by the Council and Congress, which also have a bearing on research. These are printed below.

The holding of the Seventh Pacific Science Congress was very opportune because of the coming into being of such bodies as the South Pacific Commission Research Council, the School of Pacific Studies in the national University at Canberra, the Institut Français d'Oceanie and the Regional Pacific Science Board of the National Research Council of the United States. Observers were present from the South Pacific Commission and UNESCO and World Health Organization. All these organizations will take cognizance of the research plan drawn up by the Congress and Council; in this way the Congress has made a very distinct contribution towards providing an over-all plan which will make for collaboration in research and will help to avoid overlapping.

The Resolutions

1. That the Congress commends the establishment of the South Pacific Research Council in connexion with the proposed activities of South Pacific Commission.

2. That the Congress approves the measures proposed to be taken by the Standing Committee on Pacific Conservation to co-operate with other international unions to review threatened species, to seek scientific conservation, and to secure popular support of conservation throughout the Pacific area.

3. That the Congress congratulates the Economic and Social Council of United Nations, UNESCO, and the International Union for the Protection of Nature, for convening important conservation conferences.

4. That in order to encourage wide participation by Pacific nations in the World Conference on the Protection of Nature to be held in conjunction with the United Nations Scientific Conference on the Conservation and Utilization of Resources, the Standing Committee on Pacific Conservation be designated to co-operate with UNESCO and the International Union for the Protection of Nature in the preparations being made for this Conference.

5. That the Congress recommends the setting aside, as reserves, of uninhabited islands and areas; of areas representing vegetation types; threatened areas; and areas of special scientific interest, where they occur in the Pacific region.

6. That the Congress expresses its considered satisfaction at the rapid application of conservation measures by the New Zealand Government in setting aside the habitat area of *Notornis hochstetteri* and in the steps taken to restore the fauna and flora of the Three Kings Islands by the destruction of introduced pests; and that it recommends to all governments the urgency of similar conservation of threatened species, such as *Rhinoceros sondaicus* in the Reserve in West Java, the sea-otter of Kurile Islands, the flora and fauna of Lanai in Hawaii, the short-tailed or Steller's albatross of the Bonin Islands, Laysan Rail from Laysan Island in Hawaii, the threatened fauna of the Galapagos Islands, the Kagou of New Caledonia.

7. That the Congress impresses upon the New Zealand Government the great importance of the Waipoua Kauri Forest as a sample of an unique plant association of which there is no similar example in existence, and that the Government be therefore urged to preserve absolutely intact and to maintain thus indefinitely a sufficient area surrounded by a suitable zone.

8. That the Congress recommends to the Governments of countries adhering to the Pacific Science Association that all possible means be taken to speed up and intensify the application of all practical measures of soil and water conservation within the Pacific area; that adhering countries be urged to initiate and/or complete with all possible despatch an inventory of their existing land resources and that this information be transmitted to the Food and Agriculture Organization of the United Nations.

9. That the Congress recognizes that the practices of animal and plant dealers that might threaten the maintenance or survival of certain species in their native habitats make necessary the adoption and the enforcement by all Pacific governments of regulations or laws protecting native fauna and flora and prohibiting the importation of any species protected by the country of origin unless accompanied by a certificate of lawful exportation.

10. That the Congress recognizes that the extermination of native faunas and floras by the uncontrolled introduction of aggressive exotic species necessitates a rigid control of such introductions by appropriate authorities in consultation with qualified scientists.

11. That the Congress recognizes that the protection of rare and vanishing species of fishes of aesthetic or scientific importance is worthwhile and desirable, and that conservation agencies and organizations in the Pacific should be urged to consider conservation measures in regard to such species.

12. That the Congress recommends that the wholesale and indiscriminate use of insecticides, rodenticides, herbicides, fish poisons and other chemical controls of organisms, particularly spraying from the air, should be made subject to strict control.

13. That the Congress recommends that funds derived from wildlife utilization, such as hunting and fishing licence fees, should be used for research and for the conservation and rehabilitation of such resources.

14. Whereas the position of the recently discovered Mountain Papuans in the Dutch and the Australian Territories of New Guinea, hitherto untouched by western civilization and living in a completely isolated, inaccessible and therefore easily controlled region, is a very precarious one in view of their impending contact with western civilization:

The Congress recommends that the respective governments take immediate steps

(a) to investigate the native cultures of the area, and

(b) to institute safeguards governing their contact with western civilization in order to prevent the disastrous consequences that have so frequently followed such contacts in the past.

15. That the New Zealand Government be urged to take appropriate steps to safeguard archaeological sites, both surface and monument, in New Zealand and the Chatham Islands.

16. That the Congress recommends that a continuing study of suitable methods of improvement of native agriculture be made by governments concerned with dependent peoples, such studies being aimed at the training of native personnel as demonstrators, and requests that reports on such programmes be submitted to the Eighth Pacific Science Congress.

17. That the Congress recommends the establishment of modern seismographs in south-west Australia, New Caledonia, United States Trust Territory of the Pacific Islands, British Columbia, Western Samoa, North and South Islands of New Zealand.

18. That the Congress recommends the standardization of seismic data and the acceleration of exchange of information in seismology.

19. That the Congress recommends the foundation of a Chair of Geophysics Research in the University of New Zealand.

20. That the Congress expresses strong support for the proposal from the Great Barrier Reef Committee for the establishment of a permanent marine biological station.

21. That the Congress strongly recommends to the governments of countries adhering to the Pacific Science Association that they participate in the UNESCO Book Coupon scheme in order to enable scientists to buy foreign books and periodicals.

Certain Physical Constants and Their Relation to the Doppler Shift in Radio Echoes from the Moon

A. B. THOMAS*

ABSTRACT

The Doppler frequency shift in radio echoes from the Moon is due mainly to the rotation of the Earth and the consequent velocities of the transmitter and receiver stations. Other factors are the Moon's radial motion, and the effects of the ionosphere and of reflection at the Moon's surface. A theoretical investigation has brought to light some interesting facts concerning our knowledge of the radius of the Earth and the deflection of the vertical in Sydney, and the motion of the Moon. The effects of the ionosphere, and possibly of reflection at the Moon's surface, prevent any independent determination of any of the physical constants involved by these means.

1. *Introduction*

Recent experiments (Evans Signal Laboratory, 1946; Kerr, Shain and Higgins, 1949) have shown that it is possible for radio signals of terrestrial origin to be received after reflection from the Moon, the delay being about 2·5 seconds. It has been observed that the reflected signals differ in frequency by a small amount from those transmitted. Typical values for the Australian experiments are:

Transmitter at Shepparton, Victoria;
Lat. 36°20′S. Long. 145°30′E.

Receiver at Hornsby, N.S.W.;
Lat. 33°40′S. Long. 151°05′E.

Moon's co-ordinates at Hornsby,
Azimuth 60°, Elevation 20°.

Transmitted frequency, 21·54 Mc/s.

Frequency difference between transmitted and received signals, 50 c/s approximately.

The frequency difference is attributed mainly to the relative motion between the Moon and the transmitter and receiver due to the Earth's rotation, and the consequent Doppler effect. It may be calculated that for the above conditions the Doppler frequency shift due to the Earth's rotation is about 44 c/s.

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There are other factors producing a frequency difference:

(a) The Moon has a radial motion relative to the Earth.

(b) The Moon has a small oscillatory motion, known as libration, about a line joining the Moon to the Earth. The surface of the Moon is irregular, and reflection will occur from different regions on the surface as the Moon librates. The distance of the 'echoing centre' from the Earth is thus constantly varying.

(c) The ionosphere consists of a region of ionized air between 100 Km. and 400 Km. above the Earth's surface, in which the velocity of propagation of radio waves is different from that in free space, and where radio waves may, under certain conditions, undergo reflection. The ionosphere is known to be inhomogeneous, and to have a cloud-like nature changing with time, so that the time taken for the radio signals to pass through ionosphere on their way to the Moon and back varies in a random manner.

It was suggested that accurate measurement of the frequency-difference might lead to an independent determination of one or more of the physical constants involved, such as the velocity of light and the radius of the Earth. Investigation of the magnitudes and probable errors of the various contributions to the frequency-difference, however, showed that the uncertainties of the ionosphere and of reflection at the Moon's surface precluded any such determination. Some of the results of the investigation are considered to be of sufficient general interest to warrant publication; and this paper discusses, in particular, the velocity of light, the radius of the Earth and the deflection of the vertical in New South Wales, and the orbit of the Moon.

2. *The Velocity of Light*

If the transmitter and receiver are situated at the same place, and an echoing surface moves away with a velocity v, the echo frequency will be below the transmitted frequency f by an amount f_D given by

$$f_D = \frac{2v}{c} f,$$

where f_D is the Doppler frequency shift and c is the velocity of propagation of electromagnetic waves, i.e., the velocity of light.

The frequency f is susceptible to very precise measurements, as is f_D under ideal conditions. The velocity of propagation c is not known to such a high order of accuracy. The latest reviews of its value (Birge, 1941; Warner, 1947) assign to it a probable error of $\pm$ 1·3 parts in 10^6, which is the order of accuracy to be borne in mind in the following discussion.

TABLE I

Name	Date	Where Used	Equatorial Radius, *a*	Polar Semi-diameter, *b*	Ellipticity, *e*
			miles	miles	
Everest	1830	India	6,377,340	6,356,143	1/300·8
Bessel	1841	Europe	6,377,397	6,356,079	1/299
Clarke	1858	U.S.A.	6,378,490	6,356,670	1/292·5
Clarke	1866	U.S.A.	6,378,206	6,356,584	1/295
U.S. Coast Survey	1877	U.S.A.	6,378,054	6,357,175	1/305·5
Clarke	1880	General	6,378,248	6,356,574	1/293·5
U.S. Coast Survey	1906	U.S.A.	6,378,283	6,356,971	1/297·8
Hayford	1910	General	6,378,388	6,356,909	1/297

3. *The Earth's Rotation about its Axis, and the Figure of the Earth*

Any point of the Earth's surface has a velocity due to the rotation of the Earth about its own axis. This velocity (385 m/sec. at Sydney) is given by

$$v_R = \Omega R,$$

where Ω is the angular velocity of the Earth, which is one of the fundamental measures of time, and hence of frequency; and R is the distance of the point from the axis of rotation. This distance is determined by reference to the shape and size of the Earth, and the geocentric latitude of the point considered.

The Earth is approximately spherical, with a flattening towards the poles due to its rotation. It may be represented by an ellipse rotated about its minor axis (a spheroid), and a number of such spheroids have been defined, based upon geodetic surveys in different parts of the world. Table I shows

those most commonly used during the last century.

Each spheroid in Table I is meant to represent as closely as possible the shape of the Earth over the region of the particular survey on which it was based. All except the last are approximations to the 'geoid', defined as that surface, everywhere normal to the direction taken up by a plumb-bob (the vertical), which is coincident with the mean sea-level surface over large oceans. Thus the geoid tends to follow the elevations and depressions of large land masses. Hayford calculated the effect on the vertical at each point of the geodetic survey of the U.S.A. of all the land masses and ocean basins within a radius of 2,000 miles, making due allowance for the theory of isostatic compensation (Hayford, 1909; Hayford, 1910; Lenox-Conyngham, 1923). The surface normal to the vertical corrected in this way is termed the 'compensated geoid', and represents the surface which would exist were the Earth devoid of any topographical feature, provided only that the theory of isostatic compensation has been correctly applied. Measurements of gravity in various parts of the world up to 1931 satisfied Bowie (Bowie, 1931) that, in general, the theory was in accordance with the results. Hayford's spheroid has been adopted as standard by international astronomical and geophysical associations, and has been widely used for both geodetic and astronomic calculations.

Recently some doubt has been cast upon the theory of isostasy, the objections being based mainly upon later gravity surveys (Jeffreys, 1948). Using Hayford's data, and other results based on calculations of the Moon's motion, he derives a value for the equatorial radius of the Earth smaller than Hayford's by about 6 parts in 10^5, with a probable error of about $\pm$ 3 parts in 10^6, compared with Hayford's quoted probable error of $\pm$ 3 parts in 10^6. In his original work, as Jeffreys points out, Hayford remarked that as systematic errors had not been completely eliminated, the real probable error was somewhat larger than that given. Jeffreys indicates some possible sources of systematic error, among them being the effect of isostatic compensation.

It is clear that all these spheroids are only approximations. Better approximations could be provided by an ellipsoid, or by still more complex figures. Results obtained in astronomical work are based on a mean figure of the Earth, such as Hayford's; results in geodetic surveys are generally based on a local value for the Earth's radius, or a spheroid derived from a geodetic survey in the same region. A figure for Australia was published in 1898 (Furber, 1898) with a tentative correction in 1914 (Furber, 1914) amounting to 1 part in 5,000, though full calculations were not carried through. This work was based on a very limited area, and for that reason it has not been included in the table. The present geodetic survey covering New South Wales is based on Clarke's spheroid of 1858.

Table II shows the orbital radius R for Sydney (latitude 33°51′41″S.) calculated for those of the spheroids of Table I dated after 1850.

TABLE II

Spheroid	Radius R for Sydney
	metres
Clarke 1858	5,302,260
Clarke 1866	5,301,970
U.S. Coast and Geodetic Survey 1877 ..	5,302,080
Clarke 1880	5,301,940
U.S. Coast and Geodetic Survey 1906 ..	5,301,880
Hayford 1910	5,302,100

Taking these as individual values of equal weight, we obtain a mean of 5,302,038 metres, with a standard deviation of 125 metres, and a probable error of $\pm$ 195 metres, or $\pm$ 3·8 parts in 10^6. This is the same order of error as that of Hayford's spheroid according to Jeffreys, so it is probably fair to take it as the probable error of the radius R for Sydney, assuming the quoted latitude to be the geocentric value. Here there are two possible errors, that of measurement and that due to the deflection of the vertical. Measurement errors are less than 0·1″ of arc, but the deflection of the vertical has a probable error of about $\pm$ 1·5″ of arc (see below, p. 190), giving a further error in R of $\pm$ 1 part in 10^6.

Combining these errors, the probable error of the radius R, for Sydney, is then about $\pm$ 4 parts in 10^6, and this is also that of the probable velocity of Sydney due to the Earth's rotation.

4. *The Moon's Position in the Sky, and the Deflection of the Vertical*

Having thus estimated the error in the velocity of Sydney, we have now to determine

the errors introduced by resolving that velocity in the direction of the Moon. The greatest error here is introduced by the longitude of the point of observation. The quantity required is the geocentric or geodetic longitude, whereas all astronomic observations give the astronomic longitude. The difference is the angle (in the East-West plane) between the normal to the spheroid and the plumb-bob vertical, and is known as the deflection of the vertical in the prime vertical plane. Such deflections may amount to as much as 30″ of arc.

The deflection of the vertical at any point may be determined by the following methods:

(a) Calculations of the effect of the Earth's topography, as far as 2,000 miles away from the point in question, with due regard to isostatic compensation. The probable error of results obtained by this method in U.S.A. was ± 4·0″ of arc (Hayford, 1909; Hayford, 1910); in Australia the topography is not so well known, and the errors would probably be greater.

(b) A complete gravity survey at about 2000 stations over the Earth's surface, giving a theoretical probable error of ± 0·5″ of arc (Hunter, 1935). This has not yet been made, and it is in any case a long process.

(c) A trigonometrical survey over a large area, such as U.S.A., with astronomical observations at a number of points on the survey, from which the deflection at each of these points can be determined (Hayford, 1909). This would require the present survey of New South Wales and Victoria to be extended across Australia before the accuracy would be comparable with that of the survey of U.S.A. However, some information is available (Furber, 1923).

The present survey of New South Wales is based on the Sydney Observatory, where the deflection is assumed to be zero. The deflections at various other points on the survey have been calculated, using Clarke's 1880 spheroid (see Table I) as reference. The deflections in the meridian plane, i.e., North or South, are small in nearly all cases, the mean of all the deflections without regard to sign being 2″ of arc, with a maximum deflection of 6″. A probable error of ± 1·5″ of arc represents the situation fairly well, and this should also apply to the deflection in the meridian plane in Sydney, which was assumed to be zero.

The deflections in the prime vertical plane (East or West) are not so consistent. The effects of the inland mountain plateau and the Pacific Ocean are clearly marked. For coastal stations south of Sydney, taking the deflection at Sydney as zero, the deflections vary from 7″ to 20″ or more eastwards (Furber says westwards, but this must be a slip). Inland, west of the mountain range, the deflection is the other way, but it decreases to zero and amounts to 15″ or 20″ eastward again in the regions around Bourke. This phenomenon Furber discusses at some length, since from the topography only a small deflection was expected. The explanation advanced is based upon the early history of the Australian inland basin, and the sub-surface rocks which may be present. It appears, however, that the explanation may well lie in an error in the initial assumptions, in particular that of zero deflection of the vertical at Sydney. Here the inland mountains and ocean basin would be expected to produce an eastward deflection, though not as great as at the more southerly coastal stations. The deflection might be taken as 10·0″ eastward at Sydney, leaving a residual deflection of 5·0″ to 10·0″ around Bourke, though in any calculations a large probable error, say ± 5·0″, should be allowed. It is useful to note that 10·0″ of arc corresponds to a displacement of about 1,000 feet along the Earth's surface.

The astronomical longitude of Sydney is itself subject to some degree of uncertainty. The most recent determinations are those of W. E. Cooke in 1921 (Dodwell, 1923) and the World Longitude Campaign in 1926 (La Révision, etc., 1939)—

W. E. Cooke, 1921: 10h. 4m. 48s·98 ± 0s·03,
World Longitude Campaign, 1926: 10h. 4m. 49s.19.

No probable error is given for the 1926 value in the only published account that the author has been able to trace.

5. *The Moon's Orbit*

While the main cause of the Doppler shift is the rotation of the Earth about its axis, the motion of the Moon relative to the Earth is also important. The Moon's orbit is roughly elliptical, with the Earth at one focus, and

the radial velocity at times may rise to 80 m/sec, which is appreciable compared with the velocity (385 m/sec) due to rotation. The accuracy with which the Moon's motion may be determined is again difficult to establish. Observations have been carried out widely and over a long period of time, and there are tables of the Moon's motion based upon these observations and on dynamical considerations. It is found necessary to apply corrections to these tables at intervals, the corrections being based upon the times of occultation of stars by the Moon. There is, too, a difference between the observed and calculated values for the lunar parallax, which Jeffreys (1948) explains in terms of various errors in the observations, notably the deflections of the vertical at Greenwich and Capetown. At least two standard authorities (Smart, 1944; Russell, Dugan, and Stewart, 1945) state that the calculated values are the more accurate. Such calculations involve the mean value of gravity at the Earth's surface, the mean radius of the Earth, and the period of the Moon's orbit, i.e., a lunar month. De Sitter (De Sitter, 1938) gives $\pm$ 2 parts in 10^6 and $\pm$ 5 parts in 10^6 as the probable errors of gravity and the Earth's radius respectively, but Jeffreys gives $\pm$ 2 parts in 10^6 and $\pm$ 3 parts in 10^5 for the same errors. The probable error of the lunar month is extremely small so that the dimensions of the Moon's orbit will have a probable error of rather less than $\pm$ 3 parts in 10^5. The radial velocity of the Moon can then be deduced with a probable error of $\pm$ 3 parts in 10^5.

6. *Conclusions*

As stated above, the Doppler frequency shift is given by

$$f_D = 2vf/c$$

where c is known with a probable error of $\pm$ 1·3 parts in 10^5, and the frequency f can be determined with great precision. The velocity v is made up of the rotational velocity (about 385 m/sec. in the case of Sydney, with a probable error of $\pm$ 4 parts in 10^5) resolved through an angle whose error is mainly that of the deflection of the vertical ($\pm$ 5·0″ of arc in Sydney), and the radial velocity of the Moon (maximum value 80 m/sec., probable error $\pm$ 3 parts in 10^5).

Were these the only errors involved, they could be separated and eliminated by experiments performed under appropriate conditions. The deflection of the vertical, for example, could be eliminated by pairs of observations near moonrise and moonset. The error of the Moon's radial velocity could be made negligible by observing when that velocity is small, i.e., at apogee or perigee.

It is unfortunate that larger errors than any of these are present, introduced probably by instability in the ionosphere and changes in the effective centre of reflection at the Moon. The true Doppler frequency shift is thus not susceptible to precise measurement, and consequently no determination of the constants referred to above can be made by these means.

Acknowledgements

The work described in this paper is part of the research programme of the Radiophysics Laboratory, Council for Scientific and Industrial Research, Australia. Thanks are due to Dr. R. L. Aston, of the Sydney University Civil Engineering Department, for help with the geodetic problems involved, and to Mr. Harley Wood, New South Wales Government Astronomer, and Father D. O'Connell, of Riverview College, for advice and assistance in this venture into astronomy. The conclusions drawn in each case, however, represent the author's own opinions, and no responsibility for them rests with any of the above.

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Problems of Queensland Mesozoic Palaeobotany*

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AUSTRALIAN Mesozoic deposits are largely lacustrine in character. In the Triassic, fresh-water beds were laid down over a great part of the east, and their deposition was interrupted only by a very minor incursion of the sea in the Sydney area. The Jurassic was also a period in which lacustrine sedimentation was dominant, fresh-water strata being widespread in the east and occurring together with marine beds in the west. Marine conditions were dominant in the east for a short time during the Cretaceous period and for a somewhat greater time during that period in the west, but lacustrine beds are well developed even in the Cretaceous.

In these circumstances the traces of Mesozoic life preserved to us as fossils are largely of the vegetable kingdom. In spite of this, more attention has been paid, especially of recent years, to fossils of the animal kingdom and, apart from recent work on Queensland Triassic floras, no attempts have been made to apply modern palaeobotanical techniques to Australian floras; indeed, with the exception already noted above, little palaeobotanical work of any kind has been carried out since Walkom's extensive series of papers of twenty to thirty years ago.

Carbonized Fossil Plants

Modern methods rest mainly on the study of plant tissues, especially the epidermis and the reproductive organs, the structures of which can be revealed by suitable treatment of leaves, seeds, etc., preserved as carbonaceous films; and the study of silicified wood, the structures of which can be described in detail from thin sections. The main difficulties arise from the facts that the vast majority of plant fossils are mere impressions of the leaves, carbonized fossils being comparatively rare; and that leaves, reproductive organs and wood are usually found separately, so that an important part of the work is the relating of these separate parts of the plant one to the other. Localities which yield well-preserved carbonized fossils therefore assume great importance; and fossils showing reproductive structures attached to foliage or to wood, or foliage attached to stems, are treasures.

The 'Thinnfeldia' Flora

The aptness of the term *Thinfeldia* as a comprehensive name for the Triassic floras of the southern hemisphere was emphasized recently when the writer participated in the collection, identification, and description of over six thousand specimens from the type-area of the Ipswich Series, and it was found that over fifty per cent. fell within the limits of the genus usually so called. The *Thinnfeldia* flora still presents many problems. A few of these, some of them concerned with *Thinnfeldia* itself, are briefly discussed below, but the number could be greatly extended.

1. *Problems of family relationships.* It is not yet known to what family *Thinnfeldia* belongs. The simple structure of the epidermis indicates no more than that it is a primitive gymnosperm. Two entirely different modes of reproduction have been ascribed to fronds similar in all respects, including the epidermal structure, from Queensland and South Africa respectively. Either we have to deal with two distinct families, each including similar fronds, or Thomas (1933) was wrong in ascribing certain detached reproductive structures to the South African forms; for Walkom (1917) described *attached* reproductive structures, entirely different from those described by Thomas, as the sporangia of ferns, but Harris (1926) and Thomas (1933) have both pointed out that these structures may be the microspores of a Pteridosperm.

Similar problems are presented by other genera of the flora. *Stenopteris* is probably closely related to *Thinnfeldia*, for it has a very similar epidermis; but nothing is known of its reproduction, for fertile fronds have not as yet been found.

The solution of these problems lies in the finding of fronds, not only carbonized, but also fertile.

2. *Problems of generic relationships.* Both *Thinnfeldia* and *Stenopteris* were first described from European localities, and there is considerable evidence that the southern hemisphere forms later included with them are generically distinct. In each case the epidermis of the northern forms shows important differences from that of the southern forms. In *Thinnfeldia* the epidermis of the northern forms is well known while those of the southern forms require more study; in *Stenopteris* the reverse is the case.

Forms related to *Ginkgo*, the living Maiden Hair Tree, which flourishes in Japan but which may be cultivated here, illustrate a rather different type of problem. The subdivision of this group depends on the characters of the epidermis; and, of the seven species described from the Ipswich Series, only one

* This article contains the substance of a paper read before a joint meeting of sections C and P at the meeting of the A.N.Z.A.A.S. in Hobart in January 1949.

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can be placed in the genus *Ginkgo*, a name reserved for those species which have an epidermis closely similar to that of the living tree. The epidermal characters of the others are unknown.

All these problems call for the collection and study of carbonized (fertile or infertile) fronds.

3. *Problems of specific relationships.* The eight 'species' of '*Thinnfeldia*' described from Australia have been based on the size, form and venation of the pinnules. Preliminary studies show that the epidermis of at least five of them is identical; gradational forms have been found between several of these 'species'; and further it appears that no stratigraphical significance can be attached to the 'species'. It seems likely then that these five, at least, represent simply one very variable species.

Further collection of carbonized material from different horizons and from other parts of Australia is desirable.

Relationship of the Esk Flora to the Ipswich Flora

There is little doubt that the Esk Series is the lateral equivalent of the lower portion of the Ipswich Series, for it is practically continuous in the field; and the contained fossils suggest that it is equivalent to the Kholo Stage of the Ipswich Series, for sixty-four per cent. of the Kholo species are found in the Esk Series. Nevertheless there are sufficient marked differences in the Esk flora to have led Walkom to have correlated it, in the first instance, with the Jurassic Walloon rather than the Triassic Ipswich Series—the occurrence of the conifer *Elatocladus* in Esk and Walloon but not in the Ipswich, and a much greater abundance of species of '*Thinnfeldia*' with large pinnules and of *Bennettitales* in the Esk. These differences may well be a facies difference, for the Esk Series is calcareous throughout, whereas all except the lowest horizons of the Ipswich Series are non-calcareous. The problem here is a stratigraphical rather than a palaeobotanical one; the difference in facies of the two series may be related to the areal distribution around the margins of the D'Aguilar Horst and through that to the distribution of the four divisions of the Brisbane Metamorphics (the main source of the material which formed the two series) within the D'Aguilar Horst.

Mixed Ipswich/Walloon Floras

The Walloon flora has always been easily distinguished from the Ipswich flora by the appearance of such forms as *Taeniopteris spatulata*, conifers such as *Brachyphyllum* and *Podozamites*, etc., and the abundance of *Sagenopteris*. But a problem is created by the finding of floras, as those of Cracow and North Arm, which contain a mixture of Walloon, Ispwich and/or Esk series forms. It has been suggested that these floras are representatives of the flora of Bundamba times. In the type area the Bundamba Series follows the Ipswich Series after only a short erosion interval and, except for the lowest three hundred feet, it is practically barren of fossils. The lowest six hundred feet are lithologically and in floral content little different from the Ipswich Series. F. W. Whitehouse has recently found that beds along the eastern margin of the Great Artesian Basin, believed to be the equivalent of the Bundamba Series, contain fossiliferous lenses of shale. Collection and description of fossils from these shales may solve this problem. It may also lead to the conclusion that the best line of division between the Ipswich and Bundamba Series is three hundred feet above the horizon at present taken as the base of the Bundamba.

Other Mesozoic Floras

Other Mesozoic floras in Queensland comprise that of the Brighton Beds (Lower Jurassic), and the Cretaceous floras of the Stanwell Series, the Maryborough Series, the Burrum Series, the Styx Series, Plutoville in the north, and the Winton Series. None of these is rich either in individuals or species, and further, few of the species are known by their cuticle. In these circumstances it is not easy to assign any one of them to a precise horizon. Stratigraphical information helps to fix some of them—the Winton Series and the Burrum Series overlie the fossiliferous marine Tambo and Maryborough Series respectively. The Stanwell flora was until recently regarded as Jurassic, but the description of the fauna of an interbedded marine band showed it to be early Cretaceous and emphasizes that too great a weight must not be placed on the age-determinations of the other isolated floras until they are known in more detail.

Quite a number of problems have been outlined above, but the solution of all of these would by no means complete Mesozoic palaeobotanical work in Queensland. A number of undescribed forms have recently been found in the Ipswich Series, the flora of which is the best known of all; the flora of the Brighton Beds is a recent discovery and F. W. Whitehouse has recently found a varied flora in the Blythesdale Braystone, a series which underlies and grades into the Lower Cretaceous Roma Series. These floras await description and doubtless others await discovery.

The theme of this article, then, is a plea firstly for the collection of those at-first-sight rather uninteresting plants preserved as carbonaceous films, and secondly for more detailed stratigraphical work.

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Engineering Research in Australia

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Author's Note.—During the two years since I arrived in Australia, I have had an opportunity of getting to know something of the research activities here. The following remarks embody my views at present. I realize that opinions formed in such a short time cannot be authoritative, but they may serve to stimulate interest in a discussion of research problems here.

IN December 1947, the Melbourne Division of the Institution of Engineers, Australia, published the preliminary report of its Research Sub-Committee.† This summarized the results of quite an elaborate survey, conducted by means of questionnaires, of current and contemplated research in Victoria. The terms of reference of the Sub-Committee required it to inform members (of the Institution of Engineers, Australia) of research work in progress and research facilities existing; to collaborate with such bodies as C.S.I.R.; and to collate problems for investigation.

It may be said at once that the first task has been conscientiously and effectively performed. Suggestions for expanding the work so as to fulfil the second and third of the terms of reference are made in an appendix, the main ideas being to encourage wide dissemination of information among engineers, and to provide a convenient channel by which problems can reach the research laboratories.

The main body of the Report consists of summaries, under the broad headings of Civil, Mechanical and Electrical Engineering, of replies received to the questionnaire. The cynic might comment that these replies inevitably describe the research in the most favourable light, but they do in fact give a pretty fair idea of the situation.

It may be said that the survey covered a sample which is not unrepresentative of Australia as a whole, and the following broad conclusions emerge.

(a) The bulk of the work is carried out by public bodies which have set up specialist laboratories to deal with their own specific problems. *Ad hoc* problems are naturally the main consideration, but long-term and fundamental work is tackled as opportunity offers.

(b) The relevant laboratories of C.S.I.R. have done, and are doing, important work, mainly of a fundamental character.

(c) The research done in universities and technical colleges is disappointingly small.

(d) The research done by private industry is negligible. Research Associations, such as the Aluminium Development Association in England, play little part here.

(e) The work in civil engineering is still ahead of that in electrical and mechanical engineering.

It is sometimes said that a small country cannot afford the luxury of elaborate research programmes. In actual fact, the reverse is true—small countries cannot afford to neglect research. The success of Sweden and Switzerland in certain directions is attributable to the effort they put into research. How else could S.K.F., Boving, Brown-Boveri, Sulzer, Escher-Wyss and Société-Génévoise compete so effectively in the world market?

That is not to say that the shot-gun methods of America should be followed, involving superb laboratories and huge staffs. Sweden and Switzerland, and England too, use the rifle rather than the shot-gun, but they take care to have good men to lay the aim, and an informed public which can recognize a bull's-eye.

It is probably not unfair to say that the engineering profession in Australia is not very research-minded, although of course there are many notable exceptions to the generalization. Engineers here have always been faced with the problem of the pioneer—to get something done as quickly as possible. In these circumstances it is the natural and indeed the sensible thing to make the utmost use of existing information, rather than to settle down to a prolonged study before doing anything at all. Evidence of the continued existence of this attitude can be found in many different places, but it is slowly passing with the urgency of the pioneering days. The great need is to encourage pioneering of the mind, now that the physical frontiers have been pushed back.

Many Australians deplore the continued practice of turning first to England and America for information when a new problem arises. Apart from the mental laziness which this habit encourages, it also means that Australia is always trailing along about twenty years behind the times, even in matters in which she might very well take the lead. Town-planning is perhaps on the edge of what can strictly be described as research, but it will serve as an example. Melbourne started off with one of the best plans of any city in the world, but continued maladministration is rapidly ruining it. Individuals and missions are regularly sent abroad to see what other cities are doing about tramways, and trains, and parking, and so forth: but Melbourne's problems can only be solved in Melbourne, and by people who are used to matching their brains against difficulties and to putting their ideas into practice. They should be given a chance.

In a similar way, Victoria's handling of its brown coal resources is rather disappointing. The State Electricity Commission has done an excellent job in developing Yallourn, but there are other things to do with a valuable asset than to shovel it into boilers, however

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† Engineering Research Organization and Activities, with special reference to the State of Victoria.

magnificent the shovels or ingenious the boilers. There are in Melbourne a small number of men with expert knowledge of other ways of using brown coal: if these men were formed into a team with adequate resources, they might well transform Victorian industry in a decade. That course of action has not been taken, and an overseas firm of consultants has been engaged.

It is difficult to know where to make a start in building up a new tradition, but it would do no harm if the universities were to regard research as top priority for the next few years. Research in a teaching establishment has a double value—it increases our store of knowledge; and, perhaps of more importance, it affects the young men who grow up in contact with it.

In a recent article, one of J. J. Thompson's old students told how the famous scientist used to work in a sort of corridor through which everyone had to pass to get about the building, and how they were all exhilarated by the knowledge that at any moment he might seize a convenient passer-by to lend a hand with some experiment of fundamental significance. Students who graduate in such an atmosphere are enriched for life; as they take their place in the world, they help to build up an informed opinion which values research, not only for its practical utility, but as a worthy occupation for man. Of course, we are not all J. J. Thompsons, but something very much more humble can be a wonderful inspiration to the young.

There is another reason why research in universities should be stimulated. There a man is usually free to follow his ideas wherever they may lead, without worrying too much about the fate of the problem he originally started upon. The really significant advances have mostly been made by such men, and not by workers in research establishments, bound by committees and programmes to a particular narrow field of study. Of course, there must necessarily be a good deal of this latter type of highly organized work, but too much rationalization and co-ordinating can so hamper the brilliant mind that the flashes of inspiration cannot get through.

In a recent lecture on his reminiscences, Sir Geoffrey I. Taylor painted a fascinating picture of a lifetime in what must be the ideal environment for a man with his gifts—a Chair in Cambridge and no students. That would be almost a contradiction in terms here, but Sir Geoffrey's work shows how effective such a situation can be.

There are signs that these ideas are taking root in high political quarters, and that the universities will soon be provided with more funds with which to prosecute research. Yet a new danger is now appearing; it seems to be thought that such funds should be restricted to the physical sciences, from which immediate dividends may be expected. If that is indeed the case it must be resisted strenuously. We do not really want more facts, we want more trained minds, and minds can be trained by proper investigation of problems in any subject, Philosophy or Greek, Physics or Civil Engineering. It is a commonplace that man's knowledge of his physical environment has far outstripped his social and political skill. The right course might well be to encourage study of the latter at the expense of the former, but to do the reverse is so foolish that it may be suicidal. Whose researches have had the most profound effect upon mankind—Rutherford's or Karl Marx's? The work of both these men has been startlingly fruitful, so much so that the atomic bomb, which springs from Rutherford, is regarded in some quarters as the main bulwark against Marxian Communism.

This is rather a long way from the subject of engineering research. To sum up, one can say that much good work has been done and more is in train, but the change of attitude to research, which is slowly coming, should be accelerated. The great need is for more encouragement and more support for the men with original ideas.

The Place of the National University

During the past few years the maintenance and development of Fundamental Research in the universities of Australia has received considerable attention from the Australian National Research Council and from other bodies of scientists. At the Hobart Congress of the Australian and New Zealand Association for the Advancement of Science, a public meeting was held on the night of 11 January 1949, to discuss the question of 'The Place of the Australian National University in the Academic Structure of Australia'. The discussion was opened by the Vice-Chancellor of the National University, Professor D. B. Copeland, C.M.G., M.A., D.Sc., D.Litt.

Professor Copeland dealt firstly with the apparent impression made by Government action and announcements in relation to the National University during the current process of its establishment. He emphasized that the University nevertheless enjoys the same independence as the State Universities, being similarly established under an Act, and being governed by a Council which will ultimately be modelled upon theirs. The functions of the National University, as defined under the Act, include the encouragement and provision of facilities for postgraduate research and study, together with the establishment of research schools; the provision of university education and the granting of degrees; the teaching of subjects desired for the staff of the Public Service; and the incorporation of the existing Canberra University College. The postgraduate fields are stated to be both general and related

to subjects of national importance: the research schools are specified as Medicine, Physical Science, Social Science and Pacific Studies. The Interim Council has decided first to concentrate upon the research schools; but, although the emphasis of the university establishment is upon research, undergraduate studies are not excluded.

It was suggested by Professor Copeland that the concern of the Commonwealth Government about the development of research, as indicated by the decision to establish research schools of high quality, could be used to draw attention to weaknesses in the existing universities. Within the next twenty years, and perhaps within the next five, the State universities (including other universities yet to be established) would need to provide very much more graduate study than they do at present, if the projected activities of the National University are to succeed. Although there may be some competition for money and staff during the next few years, there should be a mutual strengthening as soon as stability is reached. A two-way traffic of staff and students between the National and State Universities is to be expected. ('No one ever wants to *stay* in Canberra.')

Referring to particular difficulties of the Interim Council, Professor Copeland mentioned the desire of the Council to depend primarily upon the academic body in making academic decisions; in the fulfilment of which desire the Council has to cope with the highly individualistic character of the unusual academic personnel, the limited character of the Canberra community, and the present distance of ten thousand miles between the Council and most of its appointed academic body. He anticipated that the provision of 'University House', as a centre for staff and students, would meet with the criticism that normally comes to any great public enterprise that is conceived with imagination.

It is claimed by many that the decision to establish a standard of research, in a limited field, which does not yet exist in Australia, could better have been implemented in the existing universities. Professor Copeland questioned whether this would have effectively solved existing problems and whether it would have captured the imagination of the Australian people and the interest and support of Governments. He believed that the new university would be absorbed into the existing academic structure of Australia in such a manner as to strengthen that structure.

The following speaker was Professor Hugh K. Ward, M.C., M.B., who occupies the Chair of Bacteriology in the University of Sydney. He stressed the argument that scientific effort is built upon the State Universities as a foundation, and that the National University, being a part of the superstructure, is not independent of State Universities. The attitude of the Commonwealth Government to the present universal shortage of scientific personnel is so naïve as to expect to remedy it by giving financial assistance to cadets and students, without doing anything to provide the team of scientific workers to whom these must be attached for their training. In contrast with the idea that scholarship and research are the primary functions of a university, and that teaching and training will automatically spring from them, the State Universities are primarily and overwhelmingly occupied with vocational training at the undergraduate level for certain professions. The staffs of these universities have an uneasy feeling that the condition is to be accentuated. Although teaching is generated from research, the reverse is not true: a university which concentrates on teaching is not automatically a research centre.

Professor Copeland pointed out that even if State University grants were doubled, they would still be well behind the Provincial Universities of the United Kingdom. Professor Ward queried why the Australian Government remained unconvinced of its duty to the universities while other governments, such as those of the United Kingdom, the United States and Russia, were so convinced. He mentioned the division of Federal and State responsibilities; the relative strength of the views of the Federal Treasurer and the Universities Commission upon the needs of universities; and the lack of a realization that the significance of universities in the life and existence of a nation is any different from that of other supplicants for money. Professor Ward argued that the building up of population by means of immigration was not in itself the solution of the problem of Australian national survival—for immigrants soon adopt our demographic pattern—but that the survival of our nation depends upon the building up of a high civilization in Australia. The universities are the key to the position—not as research laboratories for the production of means for conducting warfare and defence, but as centres for providing that increase in the calibre of the people of Australia as a whole, without which no nation can expect long-term survival in the world struggle.

He proposed the establishment of a Royal Commission to consider the needs of Australian universities and the means by which these needs may be met under the Constitution—to handle the problem as a whole, instead of by the present piecemeal approach. He called attention to the Universities' Grants Commission in the United Kingdom—to its independence; its balance of personnel; the reality of its studies of particular universities; and its attitude to the universities as constituting a great public trust.

Professor Sir John Medley, the Vice-Chancellor of the University of Melbourne, believed that the Commonwealth Government had lit a candle which we could help to grow into a chandelier. The National University provided a precedent which could be followed: firstly, in having a statutory income (of £325,000 per annum after 1950), so that it is able to plan in advance of a current year;

secondly, by its scale of salary rates; thirdly, by being able to use a research fund free of cumbrous controlling machinery. Moreover, he felt that the existence and activity of the National University would stimulate, rather than exterminate, an appreciation by the State Governments of the importance of research. There is a current idea of research as a necessity for national safety; government and people still have to realize its importance as an *educational* necessity. The existence of the National University in the national seat of government will provide a pulpit whence to preach the university gospel *in partibus infidelium.*

Among succeeding speakers, Professor Alan Burn and Professor Sir John Madsen pointed out that research and research-training arise spontaneously because active brains exist in universities, and that a new and original line of thought is usually brought to a focus by one mind only, whereby new fields of interpretation and progress are opened up. Professor Ward mentioned that the organization of the National University is an unique experiment—for example, in the lack of undergraduates, and in the lack of representation within its curriculum of great departments of human knowledge and culture. He said that scientists would, as such, observe the outcome of the experiment with an open mind. Professor Madsen suggested that the research system may not succeed without an admixture of undergraduate corrective.

In a contribution to the discussion, Dr. Lyndall Worrall pointed out the different motives which activate scientific research—firstly, the simple delight of satisfying curiosity, observing, experimenting and theorizing; secondly, the starkly directed effort governed by industry or government, seeking definite limited ends; thirdly, the burning humanitarian impulse which is associated with some of the greatest names in science, to crack practical problems of tremendous benefit to men and women. Dr. Worrall believed that the pressure and power of directed research, endowed with equipment, buildings, personnel and resources on a huge scale, have put an end to dilettante research, and are informing the character and objectives of the National University under its present direction. He urged that nations, when providing resources and opportunities for scientists, should concentrate rather upon those whose humanitarian ambitions are deep and overwhelming.

Education of the Scientist

1. Chemistry

A SYMPOSIUM on chemical education* was included in the programme of Section B (Chemistry) at the Hobart meeting of A.N.Z.A.A.S., 1949. In his introduction, Professor N. S. Bayliss (Western Australia) reviewed some of the difficulties that confront chemical educators today. The great increase in the factual content of the subject and in the number and variety of new experimental techniques make it necessary to undertake a judicious revision of the conventional syllabus, from which some of the less important of the older material must be eliminated to make way for the more important of the new. Modern developments in relation to atomic and molecular theory and in knowledge of the solid state have thrown new light on many chemical phenomena, and yet in view of their mathematical background are very ¯fficult to present at the undergraduate and particularly the first-year level.

Dr. D. P. Mellor (Sydney) stated the general aims of a university course in chemistry as

(a) to acquaint students with the spirit and method of science, using chemistry as an example;
(b) to increase the depth of understanding of the subject and develop it to the point where the student can undertake original work;
(c) to teach technical skills;
(d) to develop the ability to express ideas clearly; and
(e) to train students to seek out information for themselves.

He emphasized the additional need to supply the educational and cultural background that would enable the student to view his specialized studies in relation to his general cultural and communal surroundings. Dr. Mellor then outlined how these aims are being realized in the courses in chemistry at Sydney University. In the first year, emphasis is laid on principles in a general course that must be self-sufficient, catering as it does for the needs of many students who pursue the subject no further. The laboratory course is designed to help the student to solve problems, and to encourage independence and self-reliance. (Several speakers referred to the problems of the first-year course in general chemistry, including the uneven pre-university standards amongst students and the difficulties associated with the fact that chemistry is required as a first-year subject by students in several different faculties.) The second year at Sydney is devoted to a general course in physical, inorganic and organic chemistry with some reference to the historical development of the subject and emphasis on experimental methods and fundamental principles. In the third year, selected topics are treated with more detail and with a more complete theoretical basis.

Associate-Professor E. Heymann (Melbourne) dealt more specifically with problems presented by the increasing factual content of the subject and the growing interpenetration between chemistry, physics and biology. It has become impossible to treat chemistry adequately within the scope of the conventional

* Report by Professor N. S. Bayliss.

three-year university course, and the difficulties of the teacher are accentuated by the modern trend towards larger classes. The speaker reviewed several possible solutions. One is that of increased specialization by dividing the subject into independent units such as those of inorganic, organic and physical chemistry, and allowing students to specialize in the third, or even the second, university year. A second would be to extend the duration of the undergraduate course to enable all the branches and techniques of the subject to be covered. Even the extension of the undergraduate course to four years, however, which is the (unfulfilled) policy in some Australian universities, would not be enough; and any further extension seems impracticable. Another solution would be a fundamental basic course with additional more-specialized courses that could be selected to suit individual needs. Professor Heymann, however, favoured the solution that involves the development and extension of post-graduate teaching and research, following an undergraduate course in chemistry that avoids specialization. He emphasized the fact that the best education is by apprenticeship to a teacher who is himself an active worker, and that under present conditions it is only in the post-graduate research years that one can attain the personal contact and collaboration between teacher and student that is impossible at the undergraduate stage.

Professor J. Packer (Canterbury University College), in a paper read by Professor E. E. Kurth, discussed research training under New Zealand conditions. He regarded a four-year course, leading to an honours B.Sc. or its equivalent, including the completion of the final honours written examination, as the necessary preliminary before serious research work begins. The institution of the Ph.D. at several Australian and New Zealand universities should result in much better training in research methods; some research experience (as for an M.Sc.) is a desirable prerequisite before embarking on work for the doctorate. Professor Packer drew special attention to the need for active research schools with a research tradition in which the atmosphere of research training would be one of example rather than precept. The establishment of a research tradition is of special importance in Australia and New Zealand in view of their geographical separation from the older university centres. Commenting on the establishment of the Australian National University, he expressed the opinion that existing university centres should be strengthened before the creation of a similar post-graduate institution in New Zealand.

Mr. J. N. Ellis (Sydney) discussed the requirements of training in chemical engineering, using as an example the course that has been instituted recently in the University of Sydney. He adopted the viewpoint that chemical engineering is a definite branch of engineering and should be treated as a complete subject in itself, and not merely by adding engineering units to a course in chemistry or chemistry units to a course in engineering.

The chemical engineer is a professional man whose responsibility includes not only the design of chemical processes and plant but also handling men and organizing the running of a plant. The course must be based on the fundamental subjects of mathematics, physics and chemistry. It must include basic engineering training in the principles of mechanical and electrical engineering, the study of materials, and civil engineering design. Industrial economics is also required, since the chemical engineer is responsible for the economical running of chemical plants. Superimposed on these more fundamental subjects is the need for thorough study of those special subjects that are peculiar to the chemical engineering field itself, namely, unit operations, instrumentation and chemical plant design.

The speaker indicated the way in which these various requirements were being met by the Sydney course, which should be criticized, however, for the large amount of material that had to be covered in the short time of four years. Efforts were being made to meet this criticism and some changes might be expected in the near future. The general objective in a course in chemical engineering is the same as that of any university professional course; that is, to produce people who are both educated in the broad sense and who have also been trained to apply fundamental principles to practical problems, and to take their place in any industry.

Mr. A. N. Hambly (Melbourne) discussed the need for the establishment in New South Wales and Victoria of institutes of technology whose function would be complementary to that of the universities. Referring again implicitly to the fact that the scope of modern chemistry has become too wide to be encompassed in the conventional university course, he pointed out how the necessary theoretical development of advanced university studies tends to remove them from the daily problems of chemical technology. There is a need for tertiary educational institutions of high standard which can devote themselves to the requirements of chemical industry in general, and by means of special courses to those of individual industries. At the research and post-graduate level, these institutions could concern themselves with worthy research projects with a direct bearing on technological problems. There should be no competition between such technological institutions and the universities, since their functions would be complementary. Furthermore the establishment of institutes of technology should help to remove the present evil of excessive overcrowding in the universities. Mr. Hambly stressed the need, on the one hand, for close

co-operation between technological institutions and industry, and the necessity, on the other hand, for cultural studies in any technological curriculum.

2. Geology and Geophysics

In a symposium on training in geology and geophysics which was held by Section C (Geology) at the Hobart meeting of A.N.Z.A.A.S., 1949, Professor E. S. Hills led the discussion and other contributions were made by J. M. Rayner, S. B. Dickinson, S. Warren Carey, C. M. Tattam, C. Teichert, L. E. Koch and E. de C. Clarke (in absentia). After Professor Hills had summed up, general discussion followed.

Professor Hills pointed out that geology should not be treated descriptively but analytically, with reference to the principles of physics, chemistry and biology. This required a higher standard of preparation in the basic science courses. Specialization might be desirable in the third year, though not in training the field geologist. Instruction in special techniques can be developed in post-graduate courses. In economic geology, any diversion from teaching and research at the university level is to be deplored. He indicated the desirability of periods of study-leave for persons holding economic posts. He emphasized that field instruction for students should be in areas where the geology is already well known.

Professor Clarke took the view that field excursions should form an important part of the course, but that student work should be stimulated by issuing incomplete maps. He also emphasized that engineering courses should be general in the first year.

Mr. Rayner stated that the Bureau of Mineral Resources contemplates a staff of seventy or eighty geophysicists, with about five replacements annually. He considered that trainees for such posts should take courses of instruction in Mathematics, Physics, Chemistry and Geology in the first year; Mathematics, Physics and Geology in the second year; Physics, Geology and Physics of the Earth in the third year; Physics of the Earth and Applied Geophysics in the fourth year. The last-mentioned course is not at present available in Australia. A system of cadetships has in the meantime been established by the Bureau whereby three years are spent at a university and the fourth year in the service of the Bureau.

Mr. Dickinson held the view that work on a geological survey requires some form of specialization, but favoured the idea of the officer returning to a research institution for a short period of post-graduate work. He emphasized the necessity of being able to write intelligible reports, and considered that Greek and Latin are more useful in the school training of the potential geologist than are French and German, since they are useful in geological etymology. Further, he considered that students should have practical experience on geological surveys, or with mining companies, during undergraduate years; and, though the special knowledge of the geophysicist is not necessary for the geologist, or *vice versa*, each should have some appreciation of the other's field, to allow for effective co-operation.

Dr. Teichert deplored the lack of trained palaeontologists on Government geological surveys. He emphasized the necessity for training students in palaeontology, so that they may appreciate its value in field studies. Professor Carey advocated the teaching of geomorphology, structural geology and stratigraphy, by the use of photogeology. He indicated that students should be trained in the new techniques, as aerial photographs give the geologist a new and valuable tool for geological mapping.

In summing up, Professor Hills stated that he considered the modern languages more useful to the geologist than Greek or Latin. In the general discussion which followed, Dr. Loftus Hills emphasized that a wide basic and cultural knowledge is necessary as a prerequisite for the successful geologist. He also indicated the necessity for education leading to a careful search of the geological literature for all previous records of any area being investigated. Dr. Garretty stressed the importance of a sound knowledge of fundamentals and particularly of structural geology, for the mining geologist. He considered that a course in mathematical statistics would be of benefit. Mr. Bradley deplored the low standard of teaching in geology and geography in the secondary schools; and Mr. Kleeman also felt that inadequate early pre-university training was responsible for the poor self-expression and careless spelling which occurs among undergraduates. He advocated the examination of aerial photographs in the first-year university course.

The International Unions*

International Union of Pure and Applied Physics

The sixth General Assembly of the I.U.P.A.P. was held at Amsterdam on 8 to 10 July 1948. Australia was represented by Dr. C. E. Eddy. The Assembly carried through administrative business and considered various recommendations as to nomenclature, symbols and units. It should be emphasized that these are recommendations, not decisions.

It was recommended that the unit of heat be the joule, equal to 10^7 ergs, and that the results of thermal experiments be expressed in joules. If the results are calculated from a change in temperature of water and the term 'calorie'

* An account of the 1948 meetings of the I.U. Geodesy and Geophysics and of the International Astronomical Union is to be published in the next issue of This Journal.

cannot be avoided, then the conversion factor and the limiting temperatures should be stated. Also, that the definition of the absolute temperature scale should be based on a single fixed point—the triple point of water; the numerical value of this point to be finalized by the International Bureau of Weights and Measures so as to make the new scale agree as closely as possible with the present Kelvin scale.

It was decided to ask the I.B.W.M. to accept, for international use, an *International Practical System of Units*, to comprise the metre, kilogram (mass) and second, and an electrical unit. The name 'newton' has been suggested for the unit of force on this system. While it is not proposed that physicists should abandon the C.G.S. system, it is anticipated that they will transfer to the M.K.S. system very largely, for example in electromagnetic theory. (The I.B.W.M. has instituted enquiries in all countries before deciding upon the recommendation submitted.)

The Commission on Cosmic Rays recommended that the terms 'positon' and 'negaton' be used to distinguish between the positive electron and the negative electron, still retaining the present sense of the term 'electron'; that the term 'nucleon' be used to denote both neutrons and protons; and that, as a trial, the term 'meson' be used rather than 'mesoton' or 'mesotron'.

The Commission on Units of Radioactivity proposed that a Joint Commission with the International Union of Chemistry take over the duties of the former International Radium Standard Commission and study the units, constants, standards and nomenclature of radioactivity. It was recommended as a basis for discussion that the term 'international curie' should mean the quantity of radioactive element which gives $3{\cdot}60 \times 10^{10}$ disintegrations per second.

A questionnaire is to be sent to workers on cosmic rays with the intention of collecting an *Index of Cosmicians*, which will include: purpose of research, published work, laboratories, means of research and possibilities of receiving other scientists. A symposium on cosmic rays is to be held between July and August 1949.

The Commission on Documentation discussed at length a variety of proposals for providing a comprehensive abstracting service of physical periodicals. It was realized that existing abstracting journals, while well supported individually, did not provide entirely satisfactory service. There was a need for a single abstracting service (possibly published in English and French editions) which would satisfactorily cover the world range of physical and allied periodicals, which would contain abstracts compiled in a critical manner, preferably by a specialist in the subject rather than by the author, and provide as small as possible a delay between the appearance of the original article and the abstract.

It was recommended that every original article on physics should be preceded by an abstract, independent of the text and figures of the article, and written either in English or in French, whatever may be the language of the article itself. Where circumstances permit, there should be an accompanying abstract in a second language. The scientific directors of a journal should accept responsibility for the abstract as an adequate summary of the article, rather than automatically accept a summary prepared by the author.

At this, the second General Assembly after the war, there was a greater opportunity for the meeting of Commissions, through which, on the technical side, the Assembly has perhaps its greatest value. It is to be expected that with the re-establishment of the Assembly, the value of the Union in the international field will increase year by year.

International Union of Crystallography

The first General Assembly of the I.U. Crystallography was held at Harvard University from 28 July to 3 August 1948. Commissions of the Union were established as follows, with the respective chairmen indicated: *Acta Crystallographica* (P. P. Ewald, Belfast); Structure reports (A. C. J. Wilson, Cardiff); International tables (K. Lonsdale, London); Crystallographic data (F. W. Matthews, Quebec); Crystallographic apparatus (I. Fankuchen, Brooklyn); Crystallographic nomenclature. Australia and New Zealand were not represented at the Assembly or upon the Commissions. Executive officers elected included: Honorary President, M. von Laue; President, Sir Lawrence Bragg; General Secretary, R. C. Evans, Crystallographic Laboratory, Cavendish Laboratory, Cambridge, England. It was agreed to hold the Second General Assembly and International Congress in Europe during the summer of 1951.

International Union of Scientific Radio

The Eighth General Assembly of the I.U. Scientific Radio was held at Stockholm from 12 to 23 July 1948. M. R. Bureau (France) was elected as Honorary President, Sir Edward Appleton (Great Britain) as President, C. Manneback (Belgium) as Treasurer, and E. Herbays (Belgium) as Secretary. The following Commissions were established, with presidents as indicated:

I. Measurements and Standards (J. H. Dellinger, U.S.A.);
II. Troposphere and Propagation of Waves (C. R. Burrows, U.S.A.);
III. Ionosphere and Propagation of Waves (Sir Edward Appleton, Great Britain);
IV. Terrestrial Atmospherics (H. Norinder, Sweden);
V. Radio-Noise of Extraterrestrial Origin (D. F. Martyn, Australia);
VI. Waves and Oscillations (B. v. d. Pol, Holland);
VII. Electronics (G. Lehman, France).

Delegates appointed from the Union, to other organizations, included D. F. Martyn, of Australia, to the Joint Commission on the Ionosphere; and C. W. Allen, of Australia, to the Commission for the Study of the Relations between Solar and Terrestrial Phenomena. The Ninth General Assembly is to be held in Switzerland in 1950.

Among numerous resolutions of the Assembly, it was recommended that 'power flux' be adopted in the specifications laid down, as well as 'field strength': the term 'power flux' being desirable above 200 Mc/s, and the term 'field strength' below 30 Mc/s, with an overlap between those frequencies. It was recommended that the unit of power flux be one watt per square metre, and that the use of a decibel scale relative to this flux may be convenient. A programme is being followed to establish standards for various types of noise source. Investigation is being made through various countries upon the measurement of radio-frequency power, including calorimetric and bolometric methods, and comparison of the latter with standard noise sources.

Commission on the Ionosphere

The first meeting of the Joint Commission on the Ionosphere was held at Brussels on 28-30 July 1948, under the chairmanship of Sir Edward Appleton. Australia was represented by Dr. R. v. d. R. Woolley. The Commission is 'mixed' from the I.U. Scientific Radio, I.U. Geodesy and Geophysics, and I. Astronomical Union. Work of the Commission was planned under the following fields:

- Knowledge of the ionosphere by radio sounding methods;
- Knowledge of the ionosphere from studies of pressure;
- Atomic processes in the ionosphere;
- Solar knowledge relevant to the ionosphere, and correlation of ionospheric with astrophysical phenomena;
- Knowledge of the ionosphere from studies of geomagnetism.

A series of sixteen resolutions was passed, for consideration by the appropriate Unions. These included, as No. 3:

> That, in order to complete a close network of ionospheric stations along a line of longitude and embracing both the geographical and the geomagnetic equators, the Australian authorities should be encouraged to establish further normal-incidence ionosphere sounding stations; for example, at Port Moresby and at Rabaul.

Commission on Radio-Meteorology

The Joint Commission on Radio-Meteorology met in Stockholm on 22 and 23 July 1948, under the chairmanship of C. R. Burrows, of the U.S.A. Dr. J. F. Pawsey, of Australia, attended as the representative of Dr. E. G. Bowen. The Commission decided to direct its attention, as opportunity arose, to properties of the lower atmosphere which affect radio propagation, including:

(a) factors controlling temperature and humidity profiles;
(b) temporal and spatial variations of temperature and humidity, of a random nature;
(c) radio climatology;
(d) reflection and scattering from particles and other inhomogeneities;
(e) gaseous absorption;
(f) instruments for measuring temperature, humidity, total water-vapour content, drop size, drop density, etc.;
(g) storm detection by radar;
(h) storm detection by sferics;
(i) frontal passage by field-strength measurements.

Attention is to be paid not only to fostering those aspects of meteorology which are required for radio science, but also to ways in which radio technique can be used for meteorology. The Commission sought a money grant to aid research upon:

(a) existing information available on turbulence, likely to be useful in radio meteorology, to be summarized as a report;
(b) existing data on coastal anomalies in radio meteorology, particularly the influence of the sea breeze and phenomenon of the coastal front;
(c) possibility of measuring the temperature of clouds by measuring radiation from them at microwavelengths;
(d) possibility of measuring the temperature of the lower atmosphere by measuring radiation from the water vapour contained therein.

Papers presented at the Technical Session included a number from Australia and New Zealand.

Commission on Rheology

The Joint Commission on Rheology met at Scheveningen, Holland, on 20 and 22 September 1948. Representatives attended from the I.U. Pure and Applied Physics, I.U. Chemistry, I.U. Biological Sciences, and I.U. Theoretical and Applied Mechanics. Mme. Bobry-Duciaux presided. A preliminary report on Rheological Nomenclature had been prepared, and is to be revised. A sub-committee was appointed to formulate a project on Abstracts of Rheological Publications, to serve as a basis for inviting the co-operation of interested societies and scientists. Professor Charles Sadron was charged to consider Standards for High Viscosities (up to 10^6 Poise and over) and to seek contact with committees working on the physical and chemical properties of macromolecular substances.

The International Rheological Congress met at Scheveningen from 21 to 24 September 1948. It was attended by over two hundred members. There were eight general lectures on subjects

ranging from the kinetic theory of liquids to industrial and psychological aspects of rheology. Over forty papers were presented at the sectional meetings. It is intended to hold the next Congress in 1952.

EXECUTIVE COMMITTEE

The Executive Committee of the I.C.S.U. met at Brussels on 14 and 15 September 1948. It was decided to establish Joint Commissions on Standards and Units of Radioactivity; on Spectroscopy; and on High Altitude Stations. The I.U. Biological Sciences is to establish a Commission on Natural Calamities, to which it will invite delegates from other Unions. The following resolution was conveyed to UNESCO and to national organizations adhering to I.C.S.U.:

> The Executive Committee of I.C.S.U. wishes to stress the importance of the unimpeded passage of scientists from one country to another for attending meetings of recognized scientific bodies, for visiting places of research or instruction, or for other forms of international scientific contact.
>
> With a view to facilitating the work of the consulates in any case of doubt as to the granting of a visa, the Executive Committee offers its help by naming the national adhering body which is best qualified to certify that the applicant is a *bona fide* scientist and that his application is for a genuine scientific purpose.
>
> The Executive Committee requests the Director General of UNESCO to forward this resolution to the governments of member States, with the suggestion that they may give their consulates suitable instructions.

The next General Assembly of the International Council of Scientific Unions is to be held at Copenhagen on 14 and 15 September 1949.

PATHOLOGY OF REPRODUCTION

Under the auspices of the International Union of Biological Sciences, the First International Congress on the Physio-Pathology of Reproduction and Artificial Insemination was held at Milan, from 23 to 30 June 1948. It was preceded by a Symposium on 'Inter-active Substances between Eggs and Spermatozoides and Parthogenesis'. The Congress was attended by 600 scientists representing thirty-five countries.

At the conclusion of the Congress, arrangements were made to secure collaboration on an international scale between workers in the different biological disciplines relating to artificial insemination. An Executive Committee was established with Professor Lagerlof of Sweden as President, Professors Hammond of England and Sørensen of Denmark as Vice-Presidents, and Professor Bonnadona of Italy as Secretary-General. A second Congress is to follow in three years.

INTERNATIONAL PHYTOHISTORICAL COMMITTEE

The Botanical Section of the International Union for Biological Sciences has established a Phytohistorical Committee under the chairmanship of Frans Verdoorn of the Los Angeles Arboretum, Arcadia, California, U.S.A. It will sponsor a census of current research in the history of the pure and applied biological sciences. The Committee will take over the *Index Botanicorum*, hitherto prepared under the auspices of the Arnold Arboretum of Harvard University and of *Chronica Botanica*.

The *Index Botanicorum* is to be a critical biographical dictionary of plant scientists of all time. As a preliminary, an index is first being prepared of published biographies, bibliographies, and portraits. Many hundred thousands of entries concerning about 250,000 plant scientists have now been gathered. A concise biographical dictionary, the *Indicis Botanicorum Prodromus*, is to be issued as soon as possible. Carbon copies of entries for the *Prodromus* will be sent to a selection from the many collaborators so that they may be verified, corrected or supplemented. A published list of 325 consultants includes none from New Zealand and four from Australia—P. Bibby of Melbourne; Miss C. M. Eardley of Adelaide; R. T. Patton of Melbourne; C. T. White of Brisbane. Botanical historians who may be interested, or specialists in the history of science for particular periods or regions, may communicate with Frans Verdoorn.

News

Australian National University

Professor H. S. W. Massey, F.R.S., Goldsmid Professor of Mathematics at University College, University of London, will visit the universities of Australia during August and September, at the invitation of the National University. Professor Massey originally left Australia from the University of Melbourne on an 1851 Exhibition to the Cavendish Laboratory in the University of Cambridge. During the war he was a member of the British Scientific Mission to the United States.

Tentative arrangements for Professor Massey's programme are: Brisbane, July 23-28; Armidale, July 28-30; Perth, July 31-August 4; Adelaide, August 4-10; Hobart, August 10-13; Melbourne, August 13-September 1; Canberra, September 1-22; Sydney, September 22-October 7.

Royal Australian Chemical Institute

His Majesty King George VI has been graciously pleased to confer upon the Australian Chemical Institute the title of the Royal Australian Chemical Institute.

The Masson Memorial Scholarship for 1949 has been awarded to Thomas McLeod Spots-

wood, B.Sc. of the University of Tasmania. He will undertake research work in the University of Tasmania under Dr. J. B. Polya.

Sir David Rivett

Sir David Rivett, as the only Australian yet to be elected President of the Society of Chemical Industry, will travel to England in July and preside at his first meeting of the Society.

The Royal Society

Sir Robert Robinson has been elected Honorary Member of the Parliamentary Scientific Committee of the United Kingdom. The Bakerian Lecture was delivered on 12 May by Professor H. Raistrick, F.R.S., Professor of Biochemistry in the University of London. The lectureship was founded by Henry Baker, F.R.S., for a yearly oration or discourse by one of the Fellows on some part of natural history or experimental philosophy; the first lecture was delivered in 1775.

The Croonian Lecture will be delivered on 30 June, by Dr. D. W. Bronk, who is Foreign Secretary of the National Academy of Sciences, and Chairman of the National Research Council, of the U.S.A. As Director of the Johnson Institute for Medical Physics in the University of Pennsylvania, he has greatly influenced the development of biophysics; his special field had been the physiology of the nervous system and his recent work has been upon the oxygen consumption of the brain. The Croonian Lecture was founded by one of the original Fellows of the Society, Dr. William Croone, for a lecture and illustrative experiment for the advancement of natural knowledge on local motion; the first lecture was delivered in 1738.

The Wilkins Lecture will be delivered on 15 December by Professor E. N. da C. Andrade, F.R.S., Quain Professor of Physics in the University of London. The lectureship is in the history of science, and was founded by J. D. Griffith Davies, in 1947, in commemoration of John Wilkins.

Royal Society Fellowships

The following elections to Fellowships of the Royal Society of London are additional to those of K. E. Bullen and H. R. Marston (This Journal, *11*, 163).

J. F. Allen, University of St. Andrews (low temperature physics; new phenomena shown by liquid helium). R. W. Bailey, Metro-Vickers, Manchester (behaviour of metals at high temperatures; design of turbines). F. C. Bawden, Rothamsted Experimental Station (plant viruses and virus diseases; virus serology). F. W. R. Brambell, University College of North Wales (reproduction in mammals; antenatal mortality). E. B. Chain, University of Oxford (enzymes of snake venom and bacteria; penicillin and other antibiotics). U. R. Evans, University of Cambridge (metallic corrosion). E. D. Hughes, University College, London (mechanism of the reactions of carbon compounds). W. Q. Kennedy, University of Leeds (tectonic geology and petrogenesis). W. B. R. King, University of Cambridge (Lower Palaeozoic rocks and Pleistocene deposits). Sir Ben Lockspeiser, Ministry of Supply (development of modern aircraft). J. McF. McNeill, John Brown and Co. Ltd., Clydebank (naval architecture). K. Mather, University of Birmingham (genetics; polygenic inheritance). P. B. Medawar, University of Birmingham (growth processes; tissue transplantation). W. T. J. Morgan, Lister Institute and University of London (chemistry of immunology and blood groups). N. W. Pirie, Rothamsted Experimental Station (chemical and physical properties of plant viruses). C. F. Powell, University of Bristol (experimental physics; properties of mesons). D. A. Scott, University of Toronto (chemistry of insulin, heparin and carbonic anhydrase). W. Smith, University College Hospital Medical School (virus of influenza; pathology of staphylococcal infections). G. B. B. McI. Sutherland, University of Cambridge (infra-red and Raman spectroscopy, especially of hydrocarbons). O. G. Sutton, Military College of Science, Shrivenham (atmospheric turbulence and evaporation). M. Thomas, King's College, Newcastle-on-Tyne (plant physiology; breakdown of sugar in the plant). J. M. Whittaker, University of Liverpool (theory of integral functions). F. G. Young, University College, London (role of the hormones of the anterior lobe of the pituitary gland, in carbohydrate metabolism).

University of Melbourne

The following appointments have been made: H. H. Dunning, formerly senior lecturer in Mining, as Associate Professor of Mining; R. M. Johnson, as lecturer in Civil Engineering; W. J. Tuckfield, as Acting Professor of Dental Prosthesis; E. R. Wyeth, as senior lecturer in Experimental Education and Educational Psychology. Dr. Helen Knight, sometime Fellow of Newnham College, Cambridge, has been appointed resident tutor in English at Jaent Clarke Hall. The degree of Doctor of Philosophy has been conferred upon A. S. Buchanan and B. S. Harrap, for research in Chemistry, and upon L. H. P. Jones, for research on manganese in soils. The degree of Master of Science, without examination, has been conferred upon S. L. Prescott, Master of Ormond College.

It has been recommended that the number of students to be admitted to the second year of the Medical course in 1950 will be 220, which is the same as the number fixed in 1948 and 1949. The entire estate of Mary Anne Margaret Lockie, late of 'The Caves', Mount Gambier, valued at about £75,000, has been bequeathed to the University, with the wish that the proceeds should be used for 'the advancement of Literature within Australia'. The University will receive £33,000 from the estate of the late J. N. Peters, for the endow-

ment of a Research Lectureship or Associate Professorship in Eugenics or Human Biology, or otherwise for the promotion of the study of those subjects.

Other benefactions include £3650 from the estate of H. B. Higgins, £105 from the estate of Mr. J. A. Thomson, £100 annual donation from the National Bank, £266 bursary endowment from the Henry Berry Fund, £250 from the Shell Company of Australia Ltd. for the establishment of a post-graduate scholarship in Chemistry, £21 from Dunlop Rubber Australia Ltd. for a prize in the Architecture School, £50 from Investo Manufacturing Co. Pty. Ltd. towards the salary of a research student in Metallurgy, £350 from the Zinc Corporation Ltd. as an annual amount for two years for graduate research in Metallurgy, £100 from Commonwealth Fertilizers and Chemicals Ltd. for apparatus in connexion with research on anaerobic bacteria, quarterly donations of £95 from the estate of Francis Haley and £250 from the Victorian Chamber of Manufacturers, £130 from the Mining and Metallurgical Bursaries Fund for particular bursaries and £360 from the same Fund towards maintenance of the Chair of Metallurgy for 1948. A sum of £400 has been promised from the Civil Aviation Department for a research project entitled 'A Study of the Human Elements in Air Traffic Control', under the direction of Professor Oeser.

A sum of approximately £10,000 is to be expended by the Victorian Government for the purchase of a students' hostel in connexion with the University. A property in Carlton has been selected as suitable. The hostel will be administered by three trustees —the Registrar of the University, an official of the State Treasury, and the Secretary of the Students' Representative Council.

University of Queensland

The statement made in the February issue of This Journal, *11*, 132, as to the appointment of a Professor of Geology, following an announcement previously published elsewhere, is incorrect: regret is expressed for embarrassment caused by it. Dr. F. W. Whitehouse has been appointed Associate Professor of Geology; the Chair of Geology is occupied by Professor W. H. Bryan, as announced in the preceding issue of This Journal, *11*, 91. The Chair of History has been filled by the appointment of Acting-Professor Gordon Greenwood of Sydney. Professor Greenwood graduated in 1935, with the Frazer Research Scholarship, and later proceeded to the London School of Economics and Political Science and elsewhere as Woolley Travelling Scholar. His major research interest at the present time is in the emergence and development of Australian foreign policy. The first appointee to the Chair of Architecture is R. P. Cummings, who has been the senior lecturer in architecture. Professor Cummings won a travelling scholarship in 1924 after studies at the Central Technical College, Brisbane, and proceeded to further studies in London and Rome. In 1930 he returned to Brisbane, where he has since been engaged in both the practice and teaching of his subject.

The first appointee to the Chair of Education is Professor F. J. Schonell, of the University of Birmingham. Professor Schonell is a graduate of the University of Western Australia and went to England with the award of a Hackett Research Studentship in 1928. After research and teaching in the University of London, he was appointed Professor at Swansea and later at Birmingham; his principal research has been in the psychology of the basic subjects in teaching, and in diagnostic tests and remedial measures. The University has appointed H. J. G. Hines, senior lecturer in Biochemistry, to the position of Associate Professor; he was initially appointed lecturer in Agricultural Chemistry in the University in 1929, after graduation from University College, London, and experience at Rothamsted; his main research has been in nutrition and the toxicology of native plants.

The University has received a gift for the Department of Chemistry of a Bausch and Lomb binocular microscope, a thermocouple potentiometer, and a portable pH-meter, from His Grace Archbishop Duhig. A sum of over £1000 has been subscribed to found a scholarship in the School of Classics to commemorate the late Professor Michie. Numbers of undergraduates in the various courses in 1948 were: Arts, 837 (including 406 external students); Science, 429 (8 external); Forestry, 11; Applied Science, 75; Engineering, 319; Commerce, 390 (157 external); Agriculture, 49; Law, 82 (17 external); Dentistry, 230; Medicine, 540; Veterinary Science, 62; Surveying, 36; Medical Science, 41; Education, 25; Architecture, 26; Total, 3152. Aggregate numbers in courses other than ordinary undergraduate were: Higher Degrees, 12; Honours post-graduate, 40; Miscellaneous post-graduate, 33; Diploma post-graduate (Education), 31; Diploma sub-graduate, 445; Certificate, 432; Miscellaneous unmatriculated, 205. The total of all enrolments, less duplication, was 4341.

Professor W. V. Macfarlane

The Chair of Physiology in the University of Queensland has been filled by the appointment of Dr. W. V. Macfarlane, to succeed Professor D. H. K. Lee. For his Master of Arts degree from Canterbury University College, N.Z., in 1936, Professor Macfarlane did the first New Zealand work on trematode life cycles. As a parasitologist at the Animal Research Station at Wallaceville, N.Z., he then made a study of liver fluke, followed by field studies on sheep parasites. From 1939 to 1944 Professor Macfarlane took the courses for a medical degree at the University of Otago; he presented the first N.Z. study of schistosome dermatitis, and was awarded the Junior Medal in Clinical Medicine, the Colquhon Prize and Medal, the Marjorie McCallum Memorial

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

June, 1949

EDITOR: N. H. WHITE, Faculty of Agriculture, Sydney University, Sydney.

All communications concerning abstracts should be addressed to the Editor.

Vol. 27 **No. 5**

BOTANY.

Hon. Abstractor: J. W. Vickery.

14926. **Anderson, R. H.** The Trees of New South Wales. 1947. Second Edition, 453 pp.—The revised edition of this well-known work has been considerably enlarged, notably by the inclusion of additional keys as aids to identification. These include keys to the species of *Eucalyptus*, to the larger species of *Acacia*, and to the families and genera of other trees in New South Wales. As in the first edition, the trees are described and their economic uses noted under the broad headings of the geographic areas of the State in which they are found.

14927. **Barton, E. V.** Further Notes on the Orchids of the Western Wimmera. *Vict. Nat.*, lxv (8), 1948, 200.

14928. **Beadle, N. C. W.** Studies in Wind Erosion. Part iii. Natural Regeneration on Scalded Surfaces. *J. Soil Conserv. Serv. N.S.W.*, iv (3), 1948, 123–134.—The course of natural regeneration under unstocked conditions is outlined for soft scalds, compacted clays and cemented sands. Succession is very slow, being most rapid on soft scalds and slowest on compacted clays. Exclusion of stock for nine years had little effect on the amount of pasturage produced. Annuals are usually but not always the primary colonizer. *Atriplex semibaccatum* is an important colonizer and of value in erosion control. Sandy hummocks in scalded areas support unstable plant communities unless over 167 yards wide. If grazed, smaller hummocks will decrease in size.

14929. **Beadle, N. C. W.** Studies in Wind Erosion. Part iv. Reclamation of Scalds: General Considerations. *J. Soil Conserv. Serv. N.S.W.*, iv (4), 1948, 160–170.—For reclamation of scalded surfaces, two factors at least must be carefully regulated, viz. concentration of seed and rate of infiltration of water. Ploughing is necessary, but perennials must be established in large numbers before recompaction of the soil is complete. Ecological data on the development of various plants as a result of different systems of ploughing and rainfall incidence are given.

14930. **Blake, S. T.** The Vegetation of the Country Surrounding Somerset Dam. *Qd. Nat.*, xiii (5), 1948, 94–98.—The Somerset Dam is situated on the Stanley River about 12 miles from Esk. The adjacent country is now chiefly valleys and steep mountains, the altitude varying from 200 to 2,000 feet. The vegetation close to the dam is described and new records not noted in a previous paper (1939) on the district are listed with mention of the life-form and frequency of occurrence of each.

14931. **Blake, S. T.** The Gramineæ in the Second Edition of Engler and Prantl's Die Naturlichen Pflanzenfamilien. *Australian Herbarium News*, ii, 1948, 7–9.—A review.

14932. **Blake, S. T.** Studies in Australian Apocynaceæ and Asclepiadaceæ. i. *Proc. Roy. Soc. Qd.*, lix (8), 1948, 161–168.—Six new species are described in the genera *Cerbera*, *Wrightia*, *Parsonsia* and *Marsdenia*. New combinations are published for five species in *Melodinus*, *Parsonsia*, *Cynanchium* and *Tylophora*. One species of *Cynanchium* is sunk as a synonym of *Sesamone elliptica* R.Br.

14933. **Blake, S. T.** Studies in Queensland Grasses. iii. *Proc. Roy. Soc. Qd.*, lix (7), 1948, 153–160.—Records definite Queensland localities for a number of grasses, some of which have previously been mentioned as occurring in Queensland by various authors, but without mention of locality. Two new species, *Eragrostis pergracilis* and *Eriochloa crebra*, are described, one new name, *Panicum bicoloratum*, proposed, and the identity of some other species discussed.

14934. **Camp, W. H.** Distribution Patterns in Modern Plants and the Problems of Ancient Dispersals. *Ecological Monographs*, 17, 1947, 159–183.—The hypothesis is put forward that the present distribution of fossil and living floras can be accounted for on the basis of a southern origin with no greater complications than that which demands a northern origin. A study of distribution patterns in relation to basic phyletic phenomena points rather directly to a southern origin of the angiosperms. The hypothesis is illustrated with many distribution patterns including some drawn from families and genera represented in the Australian flora.

14935. **Carter, A. N.** A Glossary of Type Nomenclature. *Vic. Nat.*, lxv (4), 1948, 92.—The more important terms of type nomenclature are defined for the convenience of those to whom more exhaustive treatments of the subject are not readily available.

14936. **Church, S. J.** A Survey of Vegetable. Matter in the Wool Clip of S.E. Australia. *Proc. Roy. Soc. Victoria*, lix (n.s.) (1), 1947, 53–62.—Vegetable matter from 123 species of plants was

identified in the 800 samples of wool examined. The species found in 5% or more of the samples from one or more zones are listed unless already recorded by Milthorpe in wool.

14937. **Coleman, Edith.** Movement in Plants. *Vic. Nat.*, lxv (5), 1948, 114–117.—Growth movements and periodic movements observed in a number of plant species are the subject of comment.

14938. **Coleman, Edith.** Interesting Movement in Scented *Alocasia, A. odora* (Roxb.) C. Koch, 1854. *Vict. Nat.*, lxv (6), 1948, 138–140.—A change of shape of the spathe is observed in *A. odora* after pollination, resulting in closure at the constricted part so as to form a collar or shelf above the female flowers. On this pollen from the male flowers above the collar is deposited and may be removed by insects.

14939. **Condon, R. W.** Mulga Death in the West Darling Country. *J. Soil Conserv. Serv. N.S.W.*, v (1), 1949, 7–14.—The widespread death of trees of Mulga (*Acacia aneura*) and Leopard-wood (*Flindersia maculosa*) in the far western districts of New South Wales is noted. The appearance of the dead and dying trees is described and the possible causes analysed. It is thought that the trees are naturally not long-lived, and natural regeneration has been prevented by stocking.

14940. **Curtis, W. M., and Somerville, J.** Boomer Marsh—A Preliminary Botanical and Historical Survey. *Pap. and Proc. Roy. Soc. Tas.*, 1947, 1948, 151–157.—A botanical survey was made of a number of localities in the hope of supplying evidence as to the likely site of Tasman's landing in Tasmania over 300 years ago, by comparison of the present flora with notes on plants found by Tasman's crew. Results suggest the probable place of the landing to have been at Boomer Marsh. This is a salt-marsh in which the following zones may be distinguished: (1) algal communities; (2) *Zostera* associes; (3) the saltings represented by *Salicornia australis* and associated plants; (4) stable meadow; (5) ridges of sand and shell; (6) pans and creeks.

14941. **Curtis, Winifred M., and Somerville, Janet.** The Vegetation. *A.S.Z.A.A.S. Handbook for Tasmania*, Hobart, 1949, 51–57.—Tasmania provides a wide range of habitats for plants. Variety in the vegetation is closely related to the varied climatic, physiographic and edaphic conditions. Sclerophyll forest is characteristic of regions of annual rainfall of less than 50 inches, and varies in its constituents with altitude and shelter. Temperate rain-forest requires a minimum rainfall of 50 inches for its development; the most widespread species in it is *Nothofagus Cunninghamii*, but several other trees are locally abundant. The Austral-Montane Formation consists of dwarf-mountain forest, mountain shrubbery, swamp, grassland and fell-field communities.

14942. **Davis, Gwenda L.** Revision of the Genus *Brachycome* Cass. Part i. Australian Species. *Proc. Linn. Soc. N.S.W.*, lxxiii (3–4), 1948, 142–241.—The distribution and affinities of the genus and component species are discussed, and definitions given of the various categories employed Characters of the anther divide the species into two distinct groups here given the status of sub-genera. Affinity between certain species is recognized by the establishment of eleven superspecies within which specific trends are discussed. Ten new species are described, and the remaining forty-two are redescribed and lectotypes usually nominated. Synonymy, type selection and intra-specific variation are discussed under each species.

14943. **Eardley, C. M.** Note on the Consultation of Russian Floras. *Australasian Herbarium News*, ii, 1948, 13–15.

14944. **Gardner, C. A.** Contributiones Floræ Australiæ Occidentalis. xii. *J. Roy. Soc. W.A.*, xxxii, 1945–46 (published 1948), 75–79.—*Pilostyles Hamiltonii* C. A. Gardn. (Rafflesiaceæ) is described as new. It is the first record of any member of the family in Australia. The new genus *Roycea* (*Chenopodiaceæ*) is described with two species *R. pycnophylloides* C. A. Gardn. and *R. spinescens* C. A. Gardn.

14945. **Garnet, J. Ros.** Excursion to Rushworth. *Vict. Nat.*, lxv (10), 1949, 224–234.—Part ii of this report contains a systematic enumeration of the vascular plants observed in the Rushworth district. Brief notes on the ecological communities observed are given.

14946. **Garnet, J. R.** Lake Mountain Camp-Out. *Vic. Nat.*, lxv (1), 1948, 6–13.—Includes general notes on the vegetation of Lake Mountain in Victoria, some 11 miles from Maryville.

14947. **Gauba, E.** Contributions to the Flora of South Australia. i. *Vic. Nat.*, lxv (5), 1948 109–113.—*Panicum decompositum* var. *viflorum* Gauba (Gramineæ) and *Corynotheca lateriflora* var. *laevisperma* Gauba (Liliaceæ) are described as new. An amended description of *Corynotheca lateriflora* (R.Br.) F. Muell. is given with notes on its structure. A few other grasses are recorded from Loveday in S.A., thus extending their known distribution.

14948. **Gauba, E.** Contributions to the Flora of South Australia. ii. *Vict. Nat.*, lxv (7), 1948, 163–168.—One new species, *Kochia decipiens*, and one new variety, *Rhagodia nutans* var. *oxycarpa*, are described. A new combination in specific rank, *Kochia erioclada*, is made based on *K. triptera* var. *erioclada* Benth. Two species of *Atriplex* are also discussed.

14949. **Gauba, E.** Contributions to the Flora of South Australia. iii. *Vict. Nat.*, lxv (8), 1948, 183–186.—Two varieties, viz. *Phyllanthus lacunarius* var. *deuterocalyx* and *Brachycome ciliaris* var. *brachyglossa*, are described as new. Several other species are discussed in the light of the author's own collections.

14950. **Gilbert, L.** Natural History of Ghoast Town. *Vict. Nat.*, lxv (5), 1948, 123–24.—Notes on the flora found near the small town of Copeland, about 10 miles west of Gloucester, N.S.W.

14951. **J.R.G.** A New Locality Record of the Elbow Orchid. *Vict. Nat.*, lxiv (12), 1948, 246–247.—*Spiculae Huntiana* is recorded from the Plenty Ranges at Kingslake in Victoria, and other Victorian records are mentioned. It is a terrestrial orchid which is evidently a holosoprophyte.

14952. **Hartley, W.** Nomenclature of Naturalised Plants. *Australasian Herbarium News*, ii, 1948, 5–7.

14953. **Hunt, T.** Family Orchidaceæ. A New Species from North Queensland. *Nth. Qd. Nat.*, xv (87), 1948, 25–26.—*Dendrobium Giddinsii* is described and figured.

14954. **Imperata cylindrica.** Taxonomy, Distribution, Economic Significance and Control. *Imp. Ag. Bur., Joint Public.* No. 7, 1944, pp. 63.—A series of articles by a number of authors on this grass species. It is widely distributed in tropical and subtropical lands, and often has adverse effects on economic crops. It can be used for thatching, paper-making and soil conservation. Methods of control are outlined.

14955. **Kieley, T. B.** Preliminary Studies on *Guignardia citricarpa* n. sp. The Ascigerous Stage of *Phoma citricarpa* McAlp. and its Relation to Black Spot of Citrus. *Proc. Linn. Soc. N.S.W.*, lxxiii (5–6), 1948 (issued 1949), 249–292.—*Guignardia citricarpa* is described from Gosford, N.S.W. The imperfect stage, *Phoma citricarpa* McAlp., has been long known as being associated with the Black Spot disease of citrus fruits. The different types of lesions caused are classified and progress through the seasons discussed. Pycnidia, spermogonia, pycnidio-sclerotia and asci have been found on dead leaves. The biology of the fungus, its significance in citrus culture, and methods of control are extensively discussed.

14956. **Lee, Alma T.** The Genus *Swainsona*. *Contributions from the New South Wales National Herbarium*, i (4), 1948, 131–271.—A systematic revision of this Australian genus of the Leguminosæ, based on an examination of all the major Australian collections. Fifty-two species are enumerated and described with full synonymy and distribution notes. Type specimens are designated. Distribution maps of each species aid in recognition of many cases of correlation between geographical areas and morphological variation within polytypic species. A number of subspecies are recognized to designate these "geographic races," while other variants are recognized as varieties. Historical and economic notes are given, the genus containing a few species which are poisonous to stock. The diagnostic features are discussed in some detail. A "natural" key to the groups of species, and an "artificial" key for convenient identification of the species are provided.

14957. **Lee, R. D.** "Cup-Flowers." *Vict. Nat.*, lxv (7), 1948, 177–178.—A note on the occurrence of *Angianthus Preissianus* near a salt-marsh in Victoria.

14958. **May, Valerie.** The Algal Genus *Gracilaria* in Australia. *Comm. Austr. C.S.I.R.* Bull. 235, 1948, pp. 63.—The criteria of value in the study of *Gracilaria* and the taxonomic procedure adopted are discussed. A series of polytypic species occurs in Australian waters. The species and forms are enumerated, described and compared. Some species have been reduced to subspecific status. Forms described as new are *G. confervoides* f. *ecortica* and f. *tumida*, *G. lichenoides* f. *complanata*, *G. Textorii* f. *tenuis*, *G. secundata* f. *pseudoflagellifera* and f. *compacta*, *G. Harveyana* f. *nana*. Where possible, relationships between Australian and various exotic species and forms are suggested. Keys to the species and forms are given.

14959. **May, Valerie.** The Seaweeds of South Australia. The Red Seaweeds by A. H. S. Lucas and Mrs. Perrin. *Australasian Herbarium News*, ii, 1948, 13.—A review.

14960. **May, Valerie.** Studies on Marine Algæ. iv. Further Geographical Records. *Proc. Linn. Soc. N.S.W.*, lxxiii (5–6), 1948 (issued 1949), 293–297.—*Hormothamnion enteromorphoides* and *Curdiea crateriformis* are recorded for the first time in Australia. Certain collections extending the known range of other species in Australian waters are reported. *Colearthrum Muelleri* is excluded from algæ known from New South Wales.

14961. **Merrill, E. D.** *Neolitsea* (Bentham) Merrill, Nomen Conservandum Propositum. *J. Arnold Arboretum*, xxix (2), 1948, 198–201.—Reasons are given for conserving *Neolitsea* against *Bryantea* Rafinesque. The Australian species generally known here as *Litsea dealbata* is placed in the genus *Neolitsea*, and the appropriate combination made.

14962. **Morris, P. F.** "Edible Pl. ts in North Queensland." *Vict. Nat.*, lxv (5), 1948, 126.—A review of a brochure under the above title by H. Flecker and S. E. Stephens.

14963. **Mort, G. W.** Stabilisation and Revegetation of Sand Drift, The Entrance North, Tuggerah Lakes. *J. Soil. Conserv. Serv. N.S.W.*, iv (3), 1948, 139–146.—An account of sand dune control effected by a combination of mechanical reshaping of the dune, laying of tea-tree brush to effect temporary surface protection, and planting with a number of plant species enumerated. The suitability of the various species is discussed.

14964. **Muir, E. T.** Orchids of the Western Wimmera. *Vict. Nat.*, lxv (1), 1948, 18–20.—Thirty-six species have been recorded from this district in Victoria, and are here listed. Notes on the distribution of the species are also given.

14965. **Muir, E. T.** West Wimmera Orchids. *Vict. Nat.*, lxv (9), 1949, 215.

14966. **Nicholls, W. H.** Two New Species of Orchids from Tasmania. *Vict. Nat.*, lxiv (12), 1948, 231–234.—*Caladenia caudata* and *Prasophyllum concinnum* are described and figured.

14967. **Nicholls, W. G.** Other records of the Elbow Orchid. *Vict. Nat.*, lxiv (12), 1948, 247.—Records of the collection of this orchid in Victoria in localities additional to those mentioned by J.R.G. in this issue.

14968. **Nicholls, W. H.** Reappearance of a "Lost" Orchid. *Vict. Nat.*, lxv (5), 1948, 120–122.—An emended description of *Prasophyllum brachystachyum* Lindl. is given and the species illustrated. The distinctness of this species has at times been doubted, and records of its occurrence have often been based on misdeterminations. I t is restricted to Tasmania, where it was first collected and has since recently been noticed. Records of its occurrence on the mainland of Australia are discredited.

14969. **Osborn, Joy E. M.** The Structure and Life History of *Hormosira banksii* (Turner) Decaisne. *Trans. and Proc. Roy. Soc. N.Z.*, lxxvii (1), 1948, 47–71.—In Australasia the brown alga *Hormosira banksii* inhabits rock platforms and rocks between tide-marks. *Hormosira* is dioecious and fertile all the year round. The cryptostomata are all potential sexual conceptacles. The oogonium contains four functional ova. The developmen of the antheridium is traced, and the process of fertilization described. The fusion nucleus is formed within one hour after the sperm has had access to the ovum. The early stages in the development of the sporeling are described. The vegetative

thallus is diploid and the haploid phase is confined to the sex organs. The gametic-zygotic chromosome numbers are tentatively determined as 12–24.

14970. **Rayment, T.** Notes on the Pollination of Trigger-Plants. *Vict. Nat.*, lxv (5), 1948, 118–119.—Several genera of bees trip the trigger of *Stylidium graminifolium*, but the Western Australian species are pollinated by four genera of flies. After flowers of the former had been "tripped" with a pin, all regained their original position within 15 minutes. After that stimulation will not cause them to "fire" until sufficient ripe pollen grains have accumulated. When ripe grains have accumulated, any slight stimulus brings about a discharge.

14971. **Reeder, John R.** The Gramineæ-Panicoideæ of New Guinea. *J. Arnold Arboretum*, xxix (3), 1948, 257–319.—This paper contains keys to and descriptions of the genera and species of the Panicoideæ known to occur in New Guinea. Many of the species are widespread, or of tropical distribution, and the paper should prove of interest to workers on the group, especially in tropical Australia.

14972. **Rupp, H. M. R.** The Monotypic Orchids of Australia and Tasmania. *Vict. Nat.*, lxv (2), 1948, 35–37.—Eleven genera of orchids in Australia are monotypic. These are enumerated, with brief notes on each. They are *Orthoceras*, *Goadbyella*, *Corunastylis*, *Townsonia*, *Rimacola*, *Burnettia*, *Leptoceras*, *Rhizanthella*, *Cryptanthemis*, *Drymoanthus* and *Mobilabium*.

14973. **Rupp, H. M. R.** Taxonomic Difficulties in the Genus *Diuris*. *Vict. Nat.*, lxiv (12), 1948, 241–243.—With the increase of material collected, this genus is becoming more difficult from the taxonomic standpoint. Many of the forms are peculiar to New South Wales. While some of these may be mere local variants, others cannot possibly be regarded as variants of previously described species. In addition to describing carefully the type of the species, authors should indicate that variants may occur. Some collections indicate that natural hybridization occurs.

14974. **Rupp, H. M. R.** What is *Caladenia gracilis* R.Br.? *Vict. Nat.*, lxv (7), 1948, 173–176—The author considers that the orchid which has been erroneously known as "*C. testacea*" in Tasmania is really *C. gracilis* R.Br., and presents evidence in support of his conclusion.

14975. **Rupp, H. M. R.** Some Notes on the Distribution of Orchids. Species Common to North Queensland and S.E. Australia. *Nth. Qd. Nat.*, xvi (89), 1948, 2–5.

14976. **Rupp, H. M. R.** *Oberonia Muelleriana* Schlr. *Qd. Nat.*, xiii (6), 1948, 116–119.—The nomenclatural history of this orchid is discussed, and differences enumerated between it and *O. iridifolia* Lindl., a species with which it was at one time linked.

14977. **Rupp, H. M. R.** The Section Genoplesium in the Genus *Prasophyllum* (Orchidaceæ). *Vict. Nat.*, lxv (6), 1948, 141–152.—Five new species, *P. anomalum*, *P. Bowdenae*, *P. mucronatum*, *P. mollissimum* and *P. obovatum*, and one new variety, *P. Morrissii* var. *intermedium*, are described. A new name is created, viz. *P. exiguum*, based on *P. rufum* Fitz., non R.Br. A number of recent collections of *Prasophyllum* spp. are recorded and a key to the section *Genoplesium* is provided. A morphological comparison is made between *P. anomalum* and *Corunastylis apostasioides* Fitz., both of which are devoid of the characteristic fusion of anther and stigma into a single structure found in the Orchidaceæ.

14978. **Sealy, J. R.** *Prostanthera melissifolia* var. *parvifolia*. *Bot. Mag.*, clxiv (4), 1948, t. 9687.—This new variety is described and figured. The species of *Prostanthera* belonging to the series Racemosæ Benth. of Section Euprostanthera Benth. are reviewed.

14979. **Smith-White, S.** Cytological Studies in the Myrtaceæ. ii. Chromosome Numbers in the Leptospermoideæ and Myrtoideæ. *Proc. Linn. Soc. N.S.W.*, lxxiii (1–2), 1948, 16–36.—Previous records of chromosome numbers in the Myrtaceæ. Reports of haploid numbers of 10 and 14 are probably erroneous. Chromosome numbers are reported for 13 genera and 63 species representative of the taxonomic subdivisions of the Leptospermoideæ and Myrtaceæ. The majority are normal diploids with a haploid chromose set of 11. There is evidence that the basic set of 11 is a derived one, probably from an original primitive set of six. Secondary polyploidy has operated at some early stage in the evolution of the family. The nature of species within the family is discussed. Most species show evidences of structural chromosomal changes giving rise to rare chromosome bridges. Polyploidy has been responsible only for a very limited degree of speciation. Five tetraphoids are reported, of which three are in *Eugenia*.

14980. **Smith-White, S.** A Survey of Chromosome Numbers in the Epacridaceæ. *Proc. Linn. Soc. N.S.W.*, lxxiii (1–2), 1948, 37–56.—Chromosome numbers are reported for 13 genera and 36 species of the Epacridaceæ. Haploid numbers of 4, 6, 7, 8, 9, 10, 12, 13 and 24 were found. The basic number is considered to be 4, and alterations have established a secondary basic set of 6. The morphology, cytology and geographical distribution of the family is discussed. A polyphyletic origin is postulated, in which the Styphelieæ and Epacrideæ have had separate origins from basic Ericales stock, and the Styphelieæ is not derived from the Epacrideæ. An unusual polarized type of pollen development is described for *Styphelia* and related genera.

14981. **Sprague, T. A.** International Rules of Botanical Nomenclature Supplement, embodying the alterations made at Amsterdam in 1935. 28 pp., cyclostyled, 1948.—The present supplement by the Rapporteur General of the Congress embodies the alterations made at the Sixth International Botanical Congress in 1935. It is based on the "Synopsis of Proposals Concerning Nomenclature" submitted to that Congress, the "Report of the Subsection of Nomenclature" containing the decisions reached, and on a typescript embodying the special provisions concerning names of fossil plants adopted by the Section of Paleobotany and accepted by the Congress. The latter is here printed as Appendix VIII of the International Rules.

14982. **Stewart, H. C. E.** An Australian Plant in Great Britain. *Vict. Nat.*, lxiv (12), 1948, 244–245.—A note on *Veronica Derwentia* and its distribution in Victoria. Its greater use as a

horticultural subject is urged. Its survival in open ground through the winter in London is recorded.

14983. **I.M.W.** A Curious *Spinifex*. *Vict. Nat.*, lxv (1), 1948, 21.—A note on *Spinifex hirsutus*, with a photograph of the flowering heads. This grass is common on the sandy coastline of southern and eastern Australia, Tasmania and New Zealand.

14984. **Wakefield, N. A., and Willis, J. H.** Victorian Fern and Clubmoss Records. i. *Vict. Nat.*, lxv (9), 1949, 215–217.—Notes on the regional distribution of eleven rare or noteworthy Victorian pteridophytes.

14985. **Wakefield, N. A.** East Gippsland Orchids. *Vict. Nat.*, lxv (9), 1949, 218–219.—Some additional records and notes.

14986. **Watson, A. E.** The *Casuarina*. *Aust. Nat.*, xi (7), 1948, 188–189.—A popular comment on the "She-oaks."

14987. **Watson, Ina.** The Green Flag. *Vict. Nat.*, lxv (3), 1948, 60–67.—A short and interesting account of the lives of Carl Linnæus and of Jean Baptiste Lamarck, and of their contributions to the study of biological science.

14988. **Watson, E. M.** The Essential Oils of the Western Australian *Eucalypts*. Part viii. The Oils of *Eucalyptus campespe* S. Moore and *E. Kochii* Maiden et Blakely. With a Note on *E. campespe* by C. A. Gardner. *J. Roy. Soc. W.A.*, xxxi, 1944–45 (published 1948), 33–35.

14989. **White, C. T.** A New Species of *Austrobaileya* (Austrobaileyaceæ) from Australia. *J. Arnold Arboretum*, xxix (3), 1948, 255–256.—*A. maculata* is described from north Queensland. When first described, this genus was provisionally placed in the Magnoliaceæ. It was later made the type of a subfamily of the Dilleniaceæ by Croizat, who subsequently gave it full family rank.

14990. **Williams, R. F.** An Ecological Study near Beraking Forest Station. *J. Roy. Soc. W.A.*, xxxi, 1944–45 (published 1948), 19–27.—The sclerophyll forest communities of the area are mapped and described. These are tentatively classified as the *Eucalyptus marginata*, the *E. calophylla-E. reduca* and the *E. patens* associations respectively. It is considered that these units are too heterogeneous to be styled plant associations, and suggested that they are more accurately described as edaphic variants. Distribution of the communities may be determined by edaphic factors.

14991. **Willis, J. H.** Vascular Flora of the Lake Mountain Alps. *Vict. Nat.*, lxv (1), 1948, 14–17.—Lake Mountain lies between the heads of the Roysten River and the Cumberland River in Victoria. Much of it is above 4,500 feet and carries a distinctly alpine flora. A systematic enumeration of the species noted is give

14992. **Willis, J. H.** Beenak Fungus Foray. *Vict. Nat.*, lxv (3), 1948, 69–70.

14993. **Willis, J. H.** On the Nature and Distribution of "Moonah" (*Melaleuca pubescens* Schauer). *Vict. Nat.*, lxv (4), 1948, 76–84.—The affinities and synonymy of *M. pubescens* is discussed and reference made to its one-time confusion with *M. Preissiana* Schauer. of W.A. Its known distribution is mapped, and some information supplied as to its ecology. *M. pubescens* woodland on Flinders Island is compared with that of *M. armillaris* on Rodondo Island.

14994. **Willis, J. H.** Meissner or Meisner. *Vict. Nat.*, lxv (5), 1948, 122.—Further evidence is put forward to show that the name of this nineteenth century botanist should be spelled Meissner, not Meisner as concluded by the same author in the *Vict. Nat.*, 1943.

14995. **Willis, J. H.** Ferdinand von Mueller. Nestor of Australian Botany. *Austr. J. Sci.*, x (5), 1948, 136–140.—A biographical sketch of this famous botanist, with notes on his travels in Australia.

14996. **Willis, J. H.** Winter Botanizing on the Mugga Mugga, Canberra. *Vict. Nat.*, lxv (8), 1948, 192–195.

GEOLOGY.

Hon. Abstractors: (1) R. O. Chalmers, (2) H. O. Fletcher.

1. GENERAL GEOLOGY.

14998. **Baker, G.** Heavy Black Sands on Some Victorian Beaches. *J. Sed. Petr.*, xv (1), 1945, 11–19.—The mineral compositions and grain size variations of the heavy black sands found on certain marine beaches in Victoria are described. The nature of the heavy beach sands and the probable source of their constituents are indicated.

14999. **Baker, G.** Phosphate Deposits near Princetown, Victoria, Australia. *J. Sed. Petr.*, xv (3), 1945, 88–92.—A one to three-foot bed containing nodules of calcium phosphate exposed in a sea cliff on the south coast of western Victoria is described. The bed is Miocene age. The P_2O_5 content of one nodule was found to be 15·08%. The deposit is not considered to have economic importance at the present time.

15000. **Baker, G., and Frostick, A. C.** Pisoliths and Ooliths from some Australian Caves and Mines. *J. Sed. Petr.*, xvii (2), 1947, 39–67.—The occurrence, nature and origin of calcareous concretions, principally of the pisolithic type, are described from caves in the following localities: (i) near Cape Schanck lighthouse on the south coast of the Mornington Peninsula, south central Victoria; (ii) the Murrendal Caves near Buchan in E. Victoria; (iii) Chillagoe, Queensland. Mines from which they are described are (*a*) Bendigo, (*b*) St. Arnaud in the Wimmera district of Victoria, (*c*) Harrietville in the north-eastern district of Victoria, (*d*) Broken Hill, and (*e*) Ballarat.

15001. **Ball, C. W.** The Heavy Mineral Assemblages of some Bundamba and Walloon Sandstones. *Proc. Roy. Soc. Qd.*, lviii, 1946, 67–70.

15002. **Beasley, A. W.** Heavy Mineral Beach Sands of Southern Queensland. *Proc. Roy. Soc. Qd.*, lix, 1948, 109–140.—An account is given of the nature, distribution and extent, and manner of formation of the heavy mineral beach sand deposits from Caloundra in southern Queensland southwards to the New South Wales border.

15003. **Blanchard, R.** Some Pipe Deposits of Eastern Australia. *Econ. Geol.*, xlii (3), 1947, 265–304.—Two general classes of pipes are dealt

with, those in granite yielding molybdenite, bismuth, wolframite and cassiterite, and those in altered sedimentaries or volcanics yielding copper and silver-lead-zinc sulphides. The distribution of the ore minerals in the pipes is dealt with.

15004. **Carroll, Dorothy.** Heavy Residues of Soils from the Lower Ord River Valley, Western Australia. *J. Sed. Petr.*, xvii (1), 1947, 8–17.—The heavy detrital minerals in several types of alluvial soil and one type derived from the disintegration of sandstones are described, and their value as indicators of the source material of the alluvium discussed.

15005. **Carroll, Dorothy, and Jones, N. K.** Laterite Developed on Acid Rocks in South-western Australia. *Soil Science*, lxiv (1), 1947, 1–15.—Three profiles representative of high-level laterite developed on gneissic and granitic rocks are described. Chemical and mineralogical examination was made, and details are given of the techniques employed.

15006. **Clarke, E. de C., and Teichert, C.** Cretaceous Stratigraphy of the Lower Murchison River Area, Western Australia. *J. Roy. Soc. W. Aust.*, xxxii, 1945–46, 19–46.—The name Murchison House Series is here proposed for the succession of sedimentary rocks which occurs on both sides of the Murchison River. The minimum thickness of the series as seen in the area is at least 750 feet. The subdivisions comprise sandstones, shales, glauconitic shales, and chalk with phosphatic nodules.

15007. **Clarke, E. de C., Teichert, C., and McWhae, J. R. H.** Tertiary Deposits near Norseman, Western Australia. *J. Roy. Soc. W. Aust.*, xxxii, 1945–46, 85–101.—It is considered that the Norseman sediments are remnants of a sheet that must once have covered a considerable area of the southern part of the Western Australian shield. They consist of spongolite, dolomite and limestone and are considered to have been deposited during the Miocene transgression.

15008. **Colditz, Margaret J.** The Petrology of the Silurian Volcanic Sequence at Wellington, N.S.W. *Proc. Roy. Soc. N.S.W.*, lxxxi (3), 1947, 180–197.—Lava types have been classed as trachyandesites, andesites, basalts and trachybasalts and these show genetic relationships with augite-lamprophyre sills elsewhere in the district. There is evidence of much deuteric activity during extrusion. Pyroclastic rocks are interbedded. Correlation is made with similar rock types at Blayney, Lucknow, Forbes and Parkes.

15009. **Connah, T. H.** Reconnaissance Survey of Black Sand Deposits, South-East Queensland. *Qd. Govt. Min. J.*, xlix, July, 1948, 223–245.—The reconnaissance survey covered over 20 miles of ocean beaches and a number of areas have been set aside as being worth closer investigation.

15010. **Cotton, C. A.** Query as to the Tempo of Australian Denudation. *Geol. Mag.*, lxxxv (1), 1948, 54–56.—The writer queries the assigning of a Pliocene age to the peneplanation of Western Australia by Teichert in his paper on the Stratigraphy of Western Australia (Abs.). Compared with eastern Australia, the rate of peneplanation in Western Australia has been unbelievably rapid, if this is the case.

15011. **Crocker, R. L.** Post-Miocene Climatic and Geologic History and its Significance in Relation to the Genesis of the Major Soil Types of South Australia. *C.S.I.R. Bull. No.* 193, 1946, pp. 56.

15012. **Edwards, A. B.** Solid Solution of Tetrahedrite in Chalcopyrite and Bornite. *Proc. Austr. Inst. Min. Met.*, Nos. 143–144, 1946, 141–155.—A tetrahedrite-chalcopyrite intergrowth apparently the product of unmixing of a solid solution, is described from the New Thologolong tungsten lode in north-eastern Victoria, and a tetrahedrite-bornite intergrowth, of similar origin, is described from the Pine Valley copper mine at Mirani, near Mackay, Queensland.

15013. **Fairbridge, R. W.** Notes on the Geomorphology of the Pelsart Group of the Houtman's Abrolhos Islands. *J. Roy. Soc. W. Aust.*, xxxiii, 1946–47, 1–36.—Observations on the reefs and submarine topography of the great central lagoon are studied in the light of the general plan and situation of the Pelsart Group near the edge of the Western Australian continental shelf. Special attention is paid to constructional and destructional processes in controlling the development of the reefs. Eustatic variations in sea-level are recognized and correlated.

15014. **Fairbridge, R. W.** Possible Causes of Intraformational Disturbances in the Carboniferous Varve Rocks of Australia. *Proc. Roy. Soc. N.S.W.*, lxxxi (2), 1947, 99–121.—The bulk of intraformational folded beds in the Carboniferous of Australia exhibit recognized characteristics of gravitational slumping and relatively few suggest direct glacial impact. The slumping is probably due to the release of water from impounded glacial lakes, overloading and other well recognized causes.

15015. **Fairbridge, R. W., and Gill, E. D.** The Study of Eustatic Changes of Sea-level. *Aust. J. Sci.*, x (3), 1947, 63–67.—The aim of this article is to indicate the suitability of Australia for the study of eustatism, to suggest the datum from which all rises and falls in sea-level should be measured, and to outline the types of evidence of eustatic change to be found in Australia.

15016. **Fisher, N. H.** The Fineness of Gold, with Special Reference to the Morobe Goldfield, New Guinea. Part i. *Econ. Geol.*, xl (7), 1945, 449–495. Part ii. *Econ. Geol.*, xl (8), 1945, 537–563.—Deals with the manner in which the fineness of the gold varies in different parts of the field, the gold itself being mostly derived from alluvial operations.

15017. **Garretty, M. D., and Blanchard, R.** Post Mine Leaching of Galena and Marmatite at Broken Hill. *Econ. Geol.*, xxxvii (5), 1942, 365–407.—Galena and the lead minerals as a whole are being leached preferentially and with greater rapidity than are marmatite and the zinc minerals as a whole. The phenomenon is not uncommon elsewhere in the Broken Hill district, but has been studied in detail only in the current stoping section of the North mine. Possible causes for preferential leaching of the lead minerals over the zinc are discussed, but a wholly satisfying explanation has not been reached. The more abundant leaching within the Northern ore body is believed to be in part due to the time lag resulting from the level development policy pursued at the North mine.

A description is given of leached derivatives of fluorite which are conspicuously developed at Broken Hill.

15018. **Gill, E. D.** Some Features of the Coastline between Port Fairy and Peterborough, Victoria. *Proc. Roy. Soc. Vict.*, lviii (1–2), 1947, 37–42.—Three types of coastline (mobile dune, consolidated dune limestone, and Miocene marine limestone) are described, with comment on the geological succession. Further evidence of a relative eustatic fall in sea-level of the order of 15 feet is adduced. Evidences of both drier and wetter climates have been found.

15019. **Gill, E. D.** Ecklin Hill—A Volcano in the Western District of Victoria. *Vict. Nat.*, lxiv (7), 1947, 130–134.—As far as the author is aware no reference has hitherto been made to this extinct volcano. The remnants of the tuff rim have formed two hills, a high one to the east and a low one to the west. The large crater (over half a mile in diameter) is swampy and filled with peat.

15020. **Gill, E. D.** Geology of the Point Lonsdale-Queenscliff Area, Victoria. *Vict. Nat.*, lxv, June, 1948, 2–10.—The Point and Queenscliff are of dune limestone (æolianite) and the country immediately behind consists of sand and shell beds deposited during a previous period of higher sea-level.

15021. **Gradwell, R.** Some Deuteric Changes in the Enoggera Granite. *Proc. Roy. Soc. Qd.*, lviii, 1946, 61–70.—A small unusual part of the Enoggera Granite was investigated to determine its origin. It is thought to have been formed by the action of gases or vapours on the main granite mass during a late stage of the magmatic cooling. Other small differentiates are described, and direct evidence for the origin of some of the associated deuteric minerals is produced.

15022. **Hanlon, F. N.** Geology of the Ashford Coalfield. *Proc. Roy. Soc. N.S.W.*, lxxxi (1), 1947, 24–33.—These coal measures outcrop in a narrow discontinuous belt over a distance of 50 miles from the Queensland border to Inverell. They overlie Carboniferous (?) rocks unconformably. Granite occurs but its relationship to the coal measures cannot be seen. Oligocene (?) basalts cover most of the southern portion of the area.

15023. **Hanlon, F. N.** A Magnetic Survey in the Vicinity of the Volcanic Neck at Dundas, N.S.W. *Proc. Roy. Soc. N.S.W.*, lxxxi (1), 1947, 69–76.—A magnetometric survey has shown three areas adjacent to the neck which seem to have been intruded by igneous rocks. These intrusions are probably basalt dykes which have weathered outcrops and tend to split and follow irregular fractures in the country rock.

15024. **Hanlon, F. N.** Geology of the North-Western Coalfield. Part i. Geology of the Willow Tree District. *Proc. Roy. Soc. N.S.W.*, lxxxi (4), 1947, 280–286.—The Permian rocks in this area form the south-western flank of an anticline whose core consists of Carboniferous strata. The Permian probably comprises the equivalents of the Lower Marine, Lower Coal, Upper Marine and Tomago Stages. The Triassic was laid down unconformably on the eroded edges of the Permian strata along the south-western boundary.

15025. **Hanlon, F. N.** Geology of the North-Western Coalfield. Part ii. Geology of the Willow Tree-Temi District. *Proc. Roy. Soc. N.S.W.*, lxxxi (4), 1947, 287–291.—The area consists of Carboniferous, Permian and Triassic rocks. The Carboniferous forms the core of an anticlinal zone and the north-eastern flank of the Temi Basin, which is occupied by sediments and volcanics of Lower Marine age.

15026. **Hanlon, F. N.** Geology of the North-Western Coalfield. Part iii. Geology of the Murrurundi-Temi District. *Proc. Roy. Soc. N.S.W.*, lxxxi (4), 1947, 292.—The area is divided into two portions by an east-west thrust fault and comprises a synclinal zone flanked by an anticlinal zone. Outcrops consist of Carboniferous, Permian, Triassic and Jurassic strata, together with Tertiary intrusions and flows. The main folding and faulting was probably late Permian age, but further considerable movement took place along the thrust at least as late as Jurassic and probably during Tertiary time.

15027. **Harris, W. J., and Thomas, D. E.** The Geology of Campbelltown. *Min. Geol. J. Vict.*, iii (3), 1948, 46–54.—This paper deals with the closely folded Ordovician strata of the area with reference to graptolite assemblages. Permian glacial beds and Tertiary volcanic rocks are also described.

15028. **Hills, E. S.** The Metalliferous Geochemical Zones of Australia. *Econ. Geol.*, xlii (5), 1947, 478–491.—Spot maps showing recorded occurrences of minerals containing certain elements as essential or important constituents have been prepared in an attempt to discover and delimit the main metalogenetic provinces of Australia. Correlation with geological events is clear in a broad way and it is shown that in Palæozoic and later times there has been a progressive shift in the location of successively developed ore-zones from west to east in eastern Australia.

15029. **Hills, E. S., and Thomas, D. E.** Fissuring in Sandstones. *Econ. Geol.*, xl (1), 1945, 51–61.—The structure known as "fissuring" is widely developed in sandstones interbedded with slates in the closely folded marine Ordovician rocks of the goldfields of central Victoria. Fissures are described and interpreted as flow layers analogous to those formed in plastically deformed metals. In fissured sandstones, two complementary sets of microscopical shearing planes are present, with the bisectrix of the acute dihedral angle between them normal to the bedding. Fissures form in both of these shearing directions and also in the plane of the flattening of the rock. Closely spaced fissures in sandstones and puckered arenaceous laminæ in slates are used in field work to indicate fold axes whose dip readings are difficult to obtain, and it is also suggested that basal deformations of sandstones may be used as a guide to faultings in disturbed strata.

15030. **Jones, O. A.** Presidential Address: Ore Genesis in Queensland. *Proc. Roy. Soc. Qd.*, lix (1), 1947, 1–91.—The main conclusion reached in this important compilation is that in Queensland there were four metallogenetic epochs, the Cloncurry (Late Pre-Cambrian), the Herberton (Late Devonian or Lower Carboniferous), the Gympie (Late Permian to Triassic), the Maryborough (Upper Cretaceous). All of these were associated with orogenesis. Some of these occurred in other States, and conversely

there were additional epochs in which ores were formed in other States but not in Queensland. With the passage of time the locus of ore deposition moved east and north-east, so that ore deposits of the Tertiary are found only in New Guinea and New Caledonia, the area of the circum-Australian geosyncline.

15031. **Mawson, D.** The Adelaide Series as Developed Along the Western Margin of the Flinders Ranges. *Trans. Roy. Soc. S. Aust.*, lxxi (2), 1947, 259–280.—These sediments which accumulated on the western side of the great geosyncline which had developed off the eastern margin of Yilgarnia during late Proterozoic to Middle Cambrian time, are of upper Proterozoic age, and equivalent to the Adelaide Series and the Nullagine Series. Attention is drawn to a remarkable correspondence, so far as the broader features of sedimentation are concerned, of the Australian record with that of South and Equatorial Africa.

15032. **McRoberts, H. M.** The General Geology of the Bombala District. *Proc. Roy. Soc. N.S.W.*, lxxxi (4), 1948, 248–266.—A plutonic complex of Kanimbla age intrudes upper Ordovician slates and upper Devonian red-beds. There are three main intrusions consisting of quartz mica diorite, granodiorite and biotite granite. An associated highly acid dyke swarm, frequently carrying garnet, is also described. Tertiary sediments and basalt cover much of the area.

15033. **McWhae, J. R. H.** The Geology and Physiography of the Lawnswood Area. *J. Roy. Soc. W. Aust.*, xxxii, 1945–46, 49–74.—This area is composed of pelitic and psammitic meta-sediments with intercalated layers of acid and basic igneous rocks all of which have suffered sillimanite zone regional metamorphism. These are early Pre-Cambrian rocks of the Jimperding Series.

15034. **Miles, K. R.** Some Western Australian Lamprophyres. *J. Roy. Soc. W. Aust.*, xxxi, 1944–45, 1–15.—These rocks from widely scattered centres in the North-west and in the Central Goldfields have been examined and described. They are everywhere intrusive into the older metamorphic rocks of the Pre-Cambrian, viz. the Older Greenstone Series.

15035. **Noakes, L. C.** A Method of Determining the Distribution of Oil in a Reservoir Rock by Means of Ultra-Violet Light. *Proc. Roy. Soc. N.S.W.*, lxxxv (3), 1947, 169–174.

15036. **Osborne, G. D.** Presidential Address: A Review of Some Aspects of the Stratigraphy, Structure and Physiography of the Sydney Basin. *Proc. Linn. Soc. N.S.W.*, lxxiii (1–2), 1948, i–xxxvii.—Several aspects of Triassic geology are discussed. Conditions of sedimentation during Narrabeen and Hawkesbury times are dealt with. Observations are made on the structure and physiography and many of the problems that await investigation are indicated.

15037. **Prider, R. T.** Igneous Activity, Metamorphism and Ore-formation in Western Australia. Presidential Address. *J. Roy. Soc. W. Aust.*, xxxi, 1944–45, 43–84.—An account of igneous activity in Archæozoic and Proterozoic time, together with the attendant mineralization is given. Since lower Cambrian times there is no evidence of igneous activity until the Tertiary, when volcanism on a very restricted scale is recognizable in the extreme northern and southern parts of the State.

15038. **Prider, R. T.** The Geology of the Darling Scarp at Ridge Hill. *J. Roy. Soc. W. Aust.*, xxxii, 1945–46, 105–129.—The Darling Scarp is ascribed to the differential erosion of hard Pre-Cambrian rocks to the east and softer later rocks to the west. Those structures which previously were considered to indicate faulting are now considered to be of late Archæozoic age and hence are much older than the postulated Darling fault.

15039. **Prider, R. T.** Chloritoid at Kalgoorlie. *Am. Min.*, xxxii, 1947, 471–474.—Gustafson in a recent paper (Abs. 13778) considers chloritoid at Kalgoorlie to be of hydrothermal origin. It is considered that hydrothermal changes have played a part, but only by way of creating a favourable alumina-rich and lime-poor environment in which chloritoid subsequently developed by low-grade dynamothermal metamorphism.

15040. **Prider, R. T.** The Geology of the Country around Tarraleah, Tasmania. *Proc. Roy. Soc. Tas.*, 1947, 127–150.—The regional geology of an area of 260 square miles on the central plateau of Tasmania is described. The most extensive formation is the Jurassic dolerite. Small Permian and Triassic inliers occur. A reclassification of the Permian is suggested. Extensive areas are covered by Tertiary basalts and smaller areas by Pleistocene glacial till. The structure of the area is dealt with.

15041. **Reeves, F.** Geology of Roma District, Queensland, Australia. *Bull. Am. Assoc. Pet. Geol.*, xxxi (8), 1947, 1341–1371.

15042. **Rowledge, H. P., and Hayton, J. D.** Two New Beryllium Minerals from Londonderry. *J. Roy. Soc. W. Aust.*, xxxiii, 1946–47, 45–52.—The Londonderry felspar quarry is situated 13 miles S.S.W. by road from Coolgardie, Western Australia. The two new minerals are bowleyite, $3[(BeCa)O].2Al_2O_3.3SiO_2.2H_2O + nLi(Na)_2O$ (*sic.*) and duplexite, $Al_2O_3.4BeO.6CaO.14SiO_2.2H_2O$. The two new minerals are associated and quartz, beryl and albite are also present. They occur in the columbite and cassiterite bearing bands of mineralization in the pegmatite. Optical data are given for both species.

15043. **Scott, Beryl.** The Geology of the Stanhope District, N.S.W. *Proc. Roy. Soc. N.S.W.*, lxxxi (4), 1947, 221–247.—Kuttung and Permian rocks were folded into a basin structure at the close of the Palæozoic. Glacial and volcanic conditions persisted throughout the Kuttung. In the volcanic series the parent magma was in the nature of a hornblende andesite which differentiated into acid and basic phases.

15044. **Shepherd, S. R. L., and Connah, T. H.** Search for Bauxite, Toowoomba District. *Qd. Govt. Min. J.*, xlix, May, 1948, 142–151.—All laterite areas were mapped and the bauxite bearing sections delineated. Tables of analyses of samples are included. Laterization and bauxitization are particularly pronounced in the areas of slower denudation west of the main scarp of the range.

15045. **Summers, H. S.** The Teachers of Geology in Australian Universities. *J. Roy. Soc. N.S.W.*, lxxxi (2), 1947, 122–146.

Medal for Medicine and the Travelling Scholarship. In 1946 he was appointed senior lecturer in Physiology in the University of Otago, being occupied in that period chiefly in neurophysiology and neurosurgery. For the degree of Doctor of Medicine he presented a study of endplate potentials in neuromuscular transmission; he was awarded a Nuffield Fellowship in 1948.

At the University of Queensland, Professor Macfarlane plans to investigate the role of the sympathetic nervous system in pain and in cortical functions, and to continue with transmission problems. Investigations in comparative physiology, and climatological work at both practical and fundamental levels, are also to be undertaken.

Naval Architecture

The first university course in Naval Architecture in Australia has been introduced in the Faculty of Engineering at the University of Queensland. The course is of four years' duration, of which the first two years coincide for the most part with the common engineering course; it leads to the degree of B.E.(Naval Architecture).

The lecturer in the subject is P. R. Salisbury, who is a Bachelor of Science in Naval Architecture of the University of Durham. After leaving England in 1946, he was with the N.S.W. State Dockyard, Newcastle, as Senior Ship Design and Estimating Draughtsman.

University of Western Australia

Leave of absence for study for a period of one year has been granted to Professor F. Alexander, Professor N. S. Bayliss, A. King and R. J. Moir, of the University staff. Professors Alexander and Bayliss have each received grants from the Carnegie Corporation of New York, for study abroad.

During the Conference in Perth of the Institution of Engineers, Australia, the degree of Doctor of Engineering was conferred by the University upon W. D. Chapman, of the Commonwealth Department of Transport; L. F. Loder, of the Commonwealth Department of Works and Housing; and T. H. Upton, of the Sydney Metropolitan Water, Sewerage and Drainage Board.

Sydney Technical College

The following appointments have been made to the staff: A. Keane and J. A. Sandford, as lecturers in Mathematics; K. N. Middleton of London, Dr. R. E. Lischmund of Leeds, and J. A. Milledge of Glasgow, as lecturers in Physics; A. V. Jopling, as lecturer in Geology; J. N. Phillips and E. S. Swinbourne, as lecturers in Physical Chemistry; J. N. Phillips and J. R. Backhouse, as lecturers in General Chemistry; R. H. Buchanan of Cornell, as lecturer in Chemical Engineering; R. A. Menzies, as lecturer in Coal Mining; O. G. Ward, A. F. Nettleton and J. L. Jenkins, as lecturers in Civil Engineering; A. K. James and A. J. Carroll, as lecturers in Mechanical Engineering; W. H. Arnold, W. M. Robertson and L. Tasny, as lecturers in Electrical Engineering; P. Spooner, as lecturer in Architecture.

At the Newcastle Technical College, R. G. Burdon has been appointed lecturer in Primary Metallurgy, and D. W. George as lecturer in Electrical Engineering.

University of Sydney

The following appointments have been made: P. L. Adams, senior lecturer in Coal Mining; R. B. Robinson, senior lecturer in Electrical Engineering. Acting-Professor J. M. Ward has been appointed to succeed the present Vice-Chancellor, Professor S. H. Roberts, to the Challis Chair of History.

The following appointments have been made to the staff of the New England University College, Armidale: Mrs. G. L. Davis, senior lecturer in Botany; Miss E. M. Spedding, lecturer in Mathematics and Physics; Dr. A. Stock, lecturer in Biology; Dr. R. C. T. Smith, senior lecturer in Mathematics.

The following donations have been received: from the Rural Bank of N.S.W., the sum of £100 for the maintenance of post-graduate refresher courses at the McGarvie Smith Animal Husbandry Farm during the Long Vacation; £7500 from the Newstead South Pastoral Co. Pty. Ltd., for research in Veterinary Surgery and Obstetrics or otherwise in Veterinary Science; £300 from the estate of the late G. H. Leibius, for Economics and/or Social Science and/or Natural Science; £100 from Dr. W. R. Browne and daughters to found the Olga Marian Browne Prize for Fieldwork in Geology; £500 from the Milk Board, for calf rearing research; £1000 from the Broken Hill Pty. Co. Ltd., for research on fluidization technique; £200 from the N.S.W. Colliery Proprietors' Association, for an assistant in coal research for six months; £1000 from James Hardie and Co. Pty. Ltd., for research in Geology; £500 from Burroughs Wellcome and Co. (Australia) Ltd., for purchase of microscopes for Veterinary Physiology; £2000 from the Rural Bank of N.S.W. to provide further equipment for the Department of Veterinary Physiology; £500 from the Rural Bank of N.S.W., for a graduate demonstrator in Veterinary Science; £1000 from the Government of N.S.W. to increase (to £2500 per annum) the grant in connexion with the neuropathological services for mental hospitals; donations of £2000 each (totalling £6000) from the Australian Dairy Produce Board, the Australian Meat Board and the Commonwealth Committee on Wool, for the Faculty of Veterinary Science; a 16-mm. sound projector, value £250, from Nicholas Pty. Ltd., Melbourne, for the Department of Obstetrics; £100 from A. Boden, of the Hardman Research Laboratories

Pty. Ltd., for repainting in the Department of Chemistry; £1000 from the late Alice M. Copeland, for cancer research.

The Scientific Societies

Royal Society of New South Wales

May: L. E. Lyons, The effect of pH upon the ultraviolet absorption spectra of pyridine type compounds.
W. R. Browne (discussion), The geology and mineral deposits of Tasmania.

June: G. K. Hughes and E. O. P. Thompson, Synthetic sex hormones—II, The pinacols and pinacolone of p-methyl-mercaptopropriophenone and the preparation of dithiodienestrol dimethyl ester.
G. E. Mapstone, Nitrogen in oil shale and shale oil—X, Nitriles in shale oil.
O. U. Vonwiller (lecture), Notes on a recent journey in Europe.
D. J. K. O'Connell (lecture), Visits to observatories in Europe and America.

Royal Society of Queensland

May: V. Grenning (lecture), Forestry in Queensland.

June (held 23 May): O. H. Selling (lecture), Upper Cretaceous and Tertiary plant remains in Subantarctica.

Royal Society of Tasmania

March: J. Pearson, The modern museum.

April: D. Martin, Eucalyptus trees in the British Isles.

May: L. W. Miller, A survey of the Aphids in Tasmania.

Royal Society of Victoria

April: W. A. Osborne (lecture), Missing mechanisms in evolution.

May: A. R. Gilchrist (lecture), Heard Island.

Royal Society of Western Australia

April: J. Shearer (lecture), Some aspects of physical science in the U.S.A.

Royal Society of South Australia

May: T. H. Johnson and L. M. Angel, Larval Trematodes from Australian freshwater molluscs.
R. C. Sprigg (film), A geologist in North America.

Medical Sciences Club of South Australia

May: Malcolm Fowler, Laboratory diagnosis of psittacosis.
H. Ferres, The influence of temperature and light on the responses of subterranean clover to zinc.

June: T. L. McLarty, Preliminary observations on hyaluronidase activity on glaucoma.
W. A. Dibden, Studies on physiological responses in nervous people.

Victorian Society of Pathology and Experimental Medicine

May: H. Doery and A Matthews, Analysis of the penicillins, with special reference to paper chromatography.
V. Wynn, Amino acids in blood plasma.
R. R. Andrew, Gastric motility.
J. W. Perry (demonstration), The kidney in polyarteritis.

Linnean Society of New South Wales

March: Daphne C. Davison, The distribution of formic and alcohol dehydrogenases in the higher plants, with particular reference to their variation in the pea plant during its life-cycle.
Daphne C. Davison, The importance of formic dehydrogenase in the oxidation mechanisms of *Pisum sativum*.
Gwenda L. Davis, Revision of the genus *Brachycome* Cass.; II, New Zealand species.
J. J. McAreavey, Australian Formicidae—New genera and species.
W. O. Steel, On Australian species of *Creophilus* (Coleoptera, Staphylinidae).
J. W. T. Armstrong, On Australian Dermestidae; V, Notes and the description of four new species.

April: Alan Burges, The genus *Dawsonia*.
Kathleen Sherrard, Graptolites from Tallong and the Shoalhaven Gorge, New South Wales.

May: Valerie May, Studies in Australian marine algae; V, Studies on the geographical records of various species, particularly those of the *Gelidium* complex.
Kathleen M. I. English, Notes on the morphology and biology of a new species of *Tabanus* (Diptera, Tabanidae).
Gwenda L. Davis, Revision of the genus *Brachycome* Cass.; III, Description of three new Australian species and some new locality records.
J. A. and Roma Dulhunty, Notes on microspore types in Tasmanian Permian coals.

Office Bearers for 1949

Royal Society of Queensland

President, D. Hill; Vice-President, M. F. Hickey; Secretary, Miss M. I. R. Scott; Treasurer, Miss D. F. Sanders; Librarian, Miss B. Baird; Editors, S. T. Blake, G. Mack; Councillors, O. A. Jones, E. M. Shepherd, A. L. Reimann, J. H. Simmonds, L. J. H. Teakle.

Linnean Society of New South Wales

President, R. N. Robertson; Vice-Presidents, Ida A. Brown, A. R. Woodhill, G. D. Osborne, Lilian Fraser; Treasurer, A. B. Walkom.

Note—The first of the lists of office bearers published in the preceding issue of This JOURNAL, *11*, 170, should have borne the sub-title, *Royal Society of New South Wales* (President, Harley Wood; etc.).

Calendar of International Conferences

1949.

April 8-15: General Assembly, International Geographical Union, Lisbon.

April 30: First International Congress of Civil Engineering, Mexico.

April 4-9: International Colloquium on the Polarization of Matter, Centre National de la Recherche Scientifique, Paris.

May: Pan-American Research Conference.

May 5-6: Bureau of International Union of Theoretical and Applied Mechanics, Paris.

May 13-20: V Meeting, International Congress of Comparative Pathology, Istanbul.

June 14-16: I.C.S.U. Committee of Science and its Social Relations, Paris.

June 20-25: UNESCO International Conference on Science Abstracting, Paris.

June 22-July 2: V International Grassland Congress, Netherlands.

July 9-23: IV Empire Mining and Metallurgical Congress, London and Oxford.

July 10-20: III World Forestry Congress, F.A.O., Helsinki.

July 21-29: II International Congress of Crop Production, I.U. Chemistry, London.

July 28-August 5: Commonwealth Veterinary Conference, C.A.B., London.

August 3-September 7: British Association for the Advancement of Science, Newcastle-on-Tyne.

August 6-13 (provisional): International Veterinary Conference, London.

August 15-19: XII International Dairy Congress, Stockholm.
August 17-September 6: United Nations Conference on Conservation and Utilization of Natural Resources, Lake Success.
August 19-25: International Biochemical Congress, Cambridge.
September 6-10: XV General Conference, International Union of Chemistry, Amsterdam.
September 12-17: International Congress of Mechanical Engineering, Paris.
September 14-16: General Assembly, International Council of Scientific Unions, Copenhagen.
October: V International Congress on Animal Husbandry, Paris.
October-November (2½ weeks): African Regional Scientific Conference, S.A.C.S.I.R., Johannesburg.

1950.
July 10-15: IV World Power Conference, London.
July 24-August 1: IV International Congress of Soil Science, Amsterdam.
August 30-September 6: Congrès International de Mathematiques, Cambridge, U.S.A.

Dates to be arranged:
General Assembly, I.U. Biological Science, Stockholm.
VII International Botanical Congress, Stockholm.
International Congress of History of Science, Bucharest.
V International Congress of Microbiology, Rio de Janiero.
XVIII International Congress of Physiology, Copenhagen.

AUSTRALIAN JOURNAL OF SCIENCE

Subscription

The Australian National Research Council has for some time issued This JOURNAL at a rate which has been heavily subsidized. Unit costs of its production have more than doubled in recent years. Moreover, the continued growth of activity in Australian science and the increasing consciousness, among scientists, of Australian media of publication, have led to expansion of the size and scope of the JOURNAL.

The Executive of the Australian National Research Council has therefore decided to fix the annual subscription to the JOURNAL at a rate of *Ten Shillings*, and the price of a single issue at *Two Shillings*, commencing with Volume 12, in August 1949.

The new rate will approach more closely to the cost of the JOURNAL and will allow it to continue to improve the service which it renders.

Date of Publication

The industrial dislocation in Australia which commenced in June has considerably delayed the appearance of this issue of the JOURNAL. It is expected that there will be a consequent, but diminishing, delay in succeeding issues. The nominal dates of publication remain unchanged.

Letters to the Editor

Original Work

Working Capital in a Plant Community

In many regions of Australia, areas with a siliceous, porous soil are undergoing severe leaching by rainwater or have been heavily leached in the past. These soils have become markedly deficient in soluble salts and are characteristically infertile. Such soils are common in Western and South Australia and, to a lesser extent, in New South Wales. In many instances, the existing soil consists of an almost pure silica-sand with only traces of soluble material and with little organic matter. Despite this, such soils may carry well-developed communities of native vegetation. The plant material in this naturally contains appreciable amounts of bases and nitrogenous material. Various workers have shown that the fallen leaves and branches of certain species return significant amounts of bases to the soil and tend to prevent the surface soil becoming as acid as it might otherwise become. During an investigation into the decomposition of fallen material from *Casuarina* growing on soil derived from the Hawkesbury sandstone, Miss J. Fraser working in the Botany School, University of Sydney, has shown that comparatively large amounts of calcium and other bases are returned to the soil in the fallen litter, and that these bases are released gradually during the decomposition of the plant debris.

A consideration of the general problem suggests that there may well be a closed circuit around which the bases and nitrogen move. In such a system the total amount of bases and nitrogen represents a 'working capital' from which a certain limited quantity of plant material may be produced. As leaves and larger parts of the plants fall to the ground and become disintegrated, and as roots die and decay, part of the bases, etc., will be made available. Most of this will again be built into new tissues, but a small amount will presumably be lost in the process. The only probable introduction of nutrients into the circuit is the addition of combined nitrogen from thunderstorms and microbiological activity. It is doubtful if the thunderstorms will contribute very much, because in a porous soil a large part of the nitrogen will be lost in drainage-water. Evaluation of microbiological nitrogen-addition is very difficult, but since most of the soils are acid, nitrogen fixation may well be small. Weathering of soil particles containing bases, and of the parent material, will tend to replace the losses; but, in a soil derived from a rock initially poor in bases or in a soil already heavily leached, the replacement will be incomplete. Under such conditions there will be a progressive loss in

capital and a consequent degeneration of the community. Any interference with the system in the way of removal of plant material from the area will represent an even more serious loss.

In the normal decay of plant debris, microbiological action releases the bases and nitrogen gradually and the losses due to heavy rain are probably not serious. Nevertheless, over a period of several thousand years, the progressive loss of capital in a siliceous soil and the subsequent degeneration of the associated plant community may become appreciable, and it is natural to wonder whether the degeneration of *Calluna* moors in the northern hemisphere is not in part at least due to such a process.

Any happening, such as a fire, which releases large amounts of ash in a readily soluble form, will lead to serious losses if heavy rain follows before the soluble ash constituents are again bound into the biological system. Quantitative data now available demonstrate that the communities which regenerate after fires on the siliceous soils derived from the Hawkesbury sandstones of the Sydney district sometimes have a lower frequency of plants per unit area than the original community. This decrease in frequency is probably the result of loss of inorganic material through leaching during the period between the fire and the re-establishment of the stable community.

If, as we have suggested, the vegetation on many of these highly leached siliceous soils is in a state of *quasi* equilibrium determined by a certain limited supply of bases, disruption of the community by fire, clearing, or erosion will lead to irreparable damage, or, in those areas where the parent material of the soil is of secondary origin, e.g., Western Australian sands, to a permanent loss of the plant communities.

N. C. W. Beadle,
Alan Burges.

School of Botany,
University of Sydney.
13 April 1949.

The Paper Partition Chromatography of Organic Anions

The possibility of separating organic acids by partition chromatography on paper was first shown by Lugg and Overell (1948), who employed a solvent swamped with formic acid in order to prevent the dissociation of the acids and thus to inhibit comet formation. Hird and Trikojus (1948) resolved a mixture of thyroxine analogues by chromatography on paper, using a solvent saturated with $2N.NH_4OH$; this rendered the acids completely ionized and the mechanism of the separation was based on the equilibrium of the anion between the two solvents. A similar solvent was employed by Lederer (1949) for the separation of inorganic anions, showing as a result that, while monovalent anions were separated, divalent ions all remained at the point of application.

The separation of a number of aromatic monocarboxylic acids will be described in this letter. The acids studied were selected as of biological importance and a method for their separation was considered to be of use to biochemists. The technique employed throughout is that of Williams and Kirby (1948) and the solvent was butanol saturated with $5N.NH_4OH$. Owing to the weakness of most of the acids, lower concentrations of ammonia did not ionize them completely.

Aminobenzoic Acids. A mixture of three isomeric aminobenzoic acids can be separated. Their R_f values are:

p-aminobenzoic acid, 0·12;
m-aminobenzoic acid, 0·19;
o-aminobenzoic acid, 0·38.

Owing to large variations, with regard to temperature, in the ionization and solubility of ammonia in the two phases, the R_f values vary somewhat with temperature; but the ratio between the R_f values is constant. The spots are shown up by spraying the paper first with dilute nitrous acid and then with sodium phenate solution. o-Aminobenzoic acid produces an orange spot; the m- and p-acids produce yellow spots.

Hydroxy Benzoic Acids. Salicylic acid has an R_f =0·60, and gives a violet spot on spraying with neutral ferric chloride. m-Hydroxy benzoic acid has an R_f = 0·27, and gives a yellow spot if sprayed with alkaline diazotized sulphanilic acid solution. p-Hydroxy benzoic acid has an R_f = 0·13; no suitable reagent was found to produce a coloured derivative, so the paper was sprayed with universal indicator and held over ammonia. Owing to a different rate of pH change on evaporation of the ammonia, the acid could then be located.

Sulphanilic Acid. Sulphanilic acid gives a yellow spot, R_f = 0·13, after spraying with nitrous acid followed by alkaline sodium phenate solution.

Phenols. Owing to the low ionization of phenols, little or no separation was achieved with ammonia-saturated butanol as solvent. Most of the phenols travel fast, and will be found near the solvent front. The Table gives the R_f values and reagents for a few which were examined.

Phenol	R_f	Detecting Reagent
o-nitro phenol	0·62	NaOH solution
m-nitro phenol	0·72	NaOH solution
p-nitro phenol	0·62	NaOH solution
α-naphthol	0·95	alkaline diazotized
β-naphthol	0·97	sulphanilic acid

The examination described indicates that paper chromatography is suitable for the detection and identification of aromatic acids and may be employed for many biochemical problems.

Thanks are due to Dr. F. H. Reuter for gifts of compounds.

Michael Lederer.
Department of Chemistry,
Sydney Technical College.
21 March 1949.

Addendum. While this letter has been in the press, a paper by B. Ekman (1948) has come to notice, in which are given the R_f values of the aminobenzoic acids in various solvents. Whereas Ekman obtains ·07 and ·08 as the maximum R_f difference between two successive aminobenzoic acids, this letter shows that differences of ·07 and ·19, respectively, were obtained by the use of butanol containing ammonia.

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The Value of Mucins in Systematic Serology

Of the various proteins of animal bodies that may be used as antigens in systematic serology, blood serum is to be preferred (Boyden, 1942). In the many cases where it is almost impossible to use this, Wilhelmi (1942) uses extracts made from lyophilized soft body tissues, from which lipid materials are first extracted. This technique has been applied to animals of the phylum Mollusca by Wilhelmi (*loc. cit.*), and Makino (1934), with results in keeping with the accepted systematic position of the animals used in the tests.

It was felt, however, that if a specific tissue or secretion could be used as an antigen in such tests, it would be preferable to the mixture of antigens that would result from the methods used by Wilhelmi or Makino. The viscous, mucinous secretion from the sole of the foot of Gasteropods is a coupled protein-carbohydrate compound, and would be, in all probability, antigenic.

For extraction of the mucin, the shells of some hundreds of the animals were cracked and the feet freed from viscera and operculum. Since this method rendered asepsis impossible, the chopped foot material was placed with an equal volume of saline in 1 oz. McCartney bottles and heated at 56° C. for thirty minutes in a water bath, then left overnight at room temperature. Phosphate-buffered saline at pH 7·4 was found to be the most successful extractant. After extraction, the mucin solution was pipetted into sterile centrifuge tubes, centrifuged for fifteen minutes, then filtered through a sintered glass disc (Pyrex SF 2A 4) and stored in the cold.

The mucin was ACRA positive (Burnet, 1948). It precipitated in a typical stringy clot on the addition of acetic acid to a concentration of one per cent. It was Biuret positive and showed marked reducing activity only after hydrolysis with two per cent. hydrochloric acid (Fehling's test). These properties held for the mucins from the following Gasteropods: *Austrocochlea torri* Gray, *Bembicium melanostoma* Philippi, *Cellana tramoserica* Sowerby, *Haliotis emmae* Gray, *Melanerita* (*Nerita*) *melanotragus* Smith, and *Siphonaria diemanensis* Sowerby.

For antiserum preparation, *Austrocochlea torri* mucin was used. Injections were given intravenously to the ear of brown buck rabbits, each animal receiving a total of 5 ml. antigen, representing a total of 20 mg. nitrogen, given on alternate days over a period of twelve days. Nine days further were allowed for incubation and the animals were then bled from the ear. The blood was allowed to clot at room temperature, the serum pipetted off, centrifuged, heated at 56° C. for thirty minutes and stored in the cold.

The 'ring test' was used to determine the precipitin titre. 0·2 ml. undiluted antiserum was layered beneath 0·25 ml. antigen in serial double dilutions. For each test the antigen was diluted from a standard dilution containing 3 mg. total nitrogen per ml. The total nitrogen content was determined by the micro-Kjeldahl method.

The titre of the homologous reaction *Austrocochlea torri* mucin / anti-*A. torri* mucin-serum was 1/1024 (1/2048 partial). The titre of the reaction of this serum against *Bambicium melanostoma* mucin was 1/8, and against *Cellana tramoserica* mucin was 1/2.

Though it is not claimed that these figures are of great systematic importance, the results demonstrate that the Gasteropod mucins are immunologically specific, but will cross-react to some extent.

Unfortunately this work must be temporarily suspended. It is hoped at a later date to investigate the carbohydrate fraction of the mucins in some detail and to study their role in the specificity. The investigation has at least demonstrated the possible value of mucins in serological studies of molluscs, and has demonstrated the species specificity of this secretion.

The author wishes to express his gratitude to Dr. F. M. Burnet, F.R.S., of the Walter and Eliza Hall Institute, Melbourne, for his frequent advice and encouragement, and to Mr. I. M. Thomas, of this Department, for constant help during the course of the work.

I. D. HISCOCK.

Department of Zoology,
University of Adelaide.
28 March 1949.

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Molybdenum in Relation to the Scald Disease of Beans

The disease of French beans (*Phaseolus vulgaris* L.), which is known as 'scald', is one which has been recorded only in the Gosford-Wyong district of New South Wales, though it

possibly occurs elsewhere. As reported by Parbery (1943), the occurrence of scald is associated both with the origin of the seed and with acid soils. Seed saved from plants grown on the acid soils of the Gosford-Wyong district and planted again on similar acid soils of the same district is liable to produce scalded plants. Seed grown outside the Gosford district almost always produces crops which show no evidence of scald. For example, no case of scald has been recorded in the Gosford-Wyong district in many crops grown there during the past ten years from seed produced at Dubbo, Wellington, Tenterfield and Maitland. Since the disease first came to the attention of the N.S.W. Department of Agriculture in 1938 there has, however, been evidence of scald in crops grown from three lines of seed produced in New South Wales outside the Gosford district. Two of these lots were from the Central Tablelands and one from the far South Coast. During recent years, bean growers in the Gosford-Wyong area have generally avoided scald by using seed grown outside their district.

As well as finding that scald was associated in the field with acid soil conditions, Parbery (1943) showed in pot experiments that the addition of sulphur to the soil would increase the tendency of the plants to scald, whilst lime or dolomite would prevent the condition developing. He also reported that bean plants showing symptoms of scald had a high content of manganese and of nitrate nitrogen. His analysis of bean seed grown in acid and in well-based soils, however, showed no differences in chemical composition which would explain why one lot of seed would produce a scalded crop and the other a healthy crop, when planted under similar conditions.

Following evidence by Davies (1945), Mitchell (1945) and Waring *et al.* (1947) that the application of molybdenum compounds would prevent or cure whiptail of cauliflowers, it appeared, for the following reasons, that the scald disease of beans might also be a molybdenum deficiency disease:

(a) Whiptail of cauliflowers occurs in those parts of the Gosford-Wyong district where bean scald also occurs.

(b) Molybdenum availability decreases as the soil becomes more acid. Whiptail of cauliflowers is, like bean scald, a disease associated with acid soils.

(c) The field evidence of the association between seed origin and occurrence of scald can be explained most satisfactorily by a deficiency of an essential element normally carried in sufficient amounts in the seed, even when planted in soils deficient in that element.

Recently, evidence in support of this hypothesis has been secured from field experiments in which applications of solutions of sodium molybdate significantly reduced, within a few days, the amount of oxidizing materials in the intervenal areas of scald-affected plants. Examination of bean plants in the field has shown that the marginal and intervenal leaf necrosis, which is characteristic of scald, is preceded by an intervenal chlorosis and that these intervenal areas are high in oxidizing materials (probably mainly nitrates) as determined by tests with a one per cent. solution of diphenylamine in concentrated sulphuric acid. Application of solutions of sodium molybdate to such plants has resulted, within a few days, in the development of a healthy green colour in the intervenal areas and a marked reduction in the amount of oxidizing materials in these areas. For example, in one field experiment, tests with the diphenylamine-sulphuric acid reagent on 8 mm.-diameter discs of intervenal leaf-tissue gave the following comparative figures for blue colour intensity. Measurement of intensity was made by visual comparison with prepared standards of aqueous solutions of nile blue sulphate, about three to five minutes after adding one 8 mm. disc of leaf-tissue to 2 ml. of the test reagent.

30 discs of leaf tissue from untreated plants: 167·2 ± 17·4.

30 discs of leaf tissue from plants watered six days earlier with sodium molybdate at the rate of 0·1 grams of the chemical in one half Imperial pint of water per yard of row: 0·3 ± 0·11.

Thus the average blue colour intensity per test was about 500 times greater for leaf-tissue from untreated plants than for similar leaf-tissue from treated plants. Significant differences have also been secured where sodium molybdate was applied in solution at rates as low as 0·001 grams per yard of row (about ¼ oz. of the chemical per acre).

These results are in agreement with the findings of Wilson and Waring (1948) for cauliflowers, Stout and Meagher (1948) for tomatoes, and Wilson (1948) for lettuce, that the intervenal leaf areas of molybdenum-deficient plants are high in nitrates and other oxidizing materials, and that these tend to disappear when molybdenum is applied. Hewitt and Jones (1947) and Mulder (1948) have also presented evidence to show that molybdenum functions in green plants as a catalyst in the reduction of nitrates.

Combined with the evidence regarding the association between seed origin and scald, the responses of scald-affected plants to molybdenum would suggest that the scald disease of beans is a molybdenum-deficiency disease, and that only when the supply of molybdenum from both the seed and the soil is inadequate do plants show symptoms of this disease.

Anderson (1948) has stated that all responses of legumes to molybdenum previously reported in Australia could be ascribed to an increase in symbiotic nitrogen-fixation. The responses of scald-affected bean plants to molybdenum as reported above, however, are apparently due to a direct effect of the molybdenum on the physiology of the bean plant. No nodules could be found by the writer on

any of the plants involved in these experiments.

The work of Parbery (1943), who reported scald-affected plants to be very high in manganese, would suggest, in the light of these findings, that molybdenum may regulate the uptake of manganese, whilst the findings of Millikan (1947) with flax would suggest that the molybdenum requirements of scald-affected plants are relatively high because of the presence in them of large amounts of manganese. An examination by the writer of figures for certain analyses of bean plants by Parbery (1941, published only in mimeographed form) has, however, failed to provide conclusive evidence that either of the two assumptions is necessarily correct. In any case, it would appear that bean seed, except when produced on soils low in available molybdenum, carries sufficient molybdenum to prevent the development of symptoms of scald, even when planted in the acid soils of the Gosford-Wyong district, which, as shown by Parbery (1943), are high in available manganese.

R. D. WILSON.

Biological Branch,
N.S.W. Department of Agriculture,
Sydney.
4 March, 1949.

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The Alkaloids of Heliotropium Europeum growing in Australia

Heliotropium sp. and related plants are poisonous to grazing animals; the plants contain small amounts of alkaloids, which cause haemorrhages in various organs and always in the liver: in sheep which are feeding on these plants, a cirrhosis of the liver develops. At the request of Dr. L. B. Bull of the Department of Animal Health, Council for Scientific and Industrial Research, a bulk of the plant was assayed for alkaloids. The alkaloid content of the specimen was small, in the order ½ to 1 mille of dry weight. Two alkaloids were separated.

The major alkaloid, present as 75 to 8[illegible] per cent. of the total alkaloids, showed the following constants, compared with those for heliotrine as given by Menshikov and Shdanovitsch in their work on *Heliotropium lasiocarpum*:

	Heliotrine	Australian Alkaloid
Melting point	125° to 126°	126° to 127°
Specific rotation (chloroform)	−75°	+49·3°
Mol. weight by titration ..	313	314
Derivatives — hydrolysis products:		
Yield of acid	56·8%	56·6%
Mol. weight of acid (titration)	176	178
Melting point of acid ..	92·5° to 94·5°	94°
Sp. rotation of acid (water)	−12°	−12°
Melting point of base. HCl	122° to 124°	1[illegible]° to 126°
Mol. weight (HCl determination)	156·5	156
Methiodide melting point	110° to 111°	113°

The data obtained with the Australian alkaloid are all slightly higher than those given by the Russian workers for heliotrine and its hydrolysation products heliotridine and heliotric acid, except for the optical rotation of the alkaloid, which is opposite: +49·3° compared with −75° for heliotrine. This constant has been checked on various fractions of the alkaloid, separated at different stages and procedures of the purification: it was shown to be constant. The values found for the physical constants of the hydrolysis-products justify the assumption that the acid and basic constituent of the alkaloid are identical with those of heliotrine. It is considered that the main alkaloid of the Australian plant is an optical isomer of heliotrine: the name isoheliotrine is proposed.

The minor alkaloid gave the following constants, compared with lasiocarpine as given by Menshikov and Schdanovitsch:

	Lasiocarpine	Aust. alkaloid
Melting point	94° to 95·5°	96°
Molecular weight by titration	411	411
Spec. rotation in alcohol	−4°	−4°

As only very little of the pure alkaloid was available for chemical identification, hydrolysis was not attempted. The constants shown, together with the solubility in ether and petrolether, as established during extraction and purification, are identical with those of lasiocarpine. The alkaloid is presumed to be lasiocarpine.

Experimental

The milled drug was macerated and then exhaustively percolated with 90 per cent. alcohol. The percolate was concentrated under a vacuum, at temperatures not exceeding 55° at the start and 50° later. The concentrate was carefully acidified with 10 per cent. phosphoric acid to a pH of 3 to 3·5, and twice thoroughly washed with trichlorethylene. The trichlorethylene layers were separated, washed with water, and the washings combined with the acid liquors; the final pH was 3·4. Caustic potash solution was added to a pH of 10, and the alkaloids extracted three times with tri-

chlorethylene. The combined trichlorethylene extracts were concentrated under a vacuum, at temperatures not exceeding 55°. No trouble from emulsions was experienced at any stage.

The concentrated trichlorethylene extracts were exhaustively extracted with ether. The combined ether-extracts were concentrated, and the residue extracted with hot petrolether (B.P., 90° to 110°). After slight concentration of the petrolether extracts, crude lasiocarpine crystallized slowly on cooling and standing. Very little of it could be found in the mother liquor. The crude alkaloid is contaminated with small amounts of the main-alkaloid and purified by repeated re-crystallization from petrolether.

The residue from the ether-extraction solidified after complete removal of the solvents to a black semi-crystalline mass. This was dissolved in hot acetone and allowed to crystallize on ice. The crystals of crude iso-heliotrine were separated and purified by alternative crystallizations from hot benzene and acetone, and repeated washings with ether, in which the alkaloid is practically insoluble. In preparing the derivatives the procedure employed by Menshikov and Schdanovitsch was followed.

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8 March 1949.

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Reviews

Agriculture

Crop Management and Soil Conservation, 2nd edition. By Joseph F. Cox and Lyman E. Jackson. (New York: John Wiley; London: Chapman and Hall, 1948. 572 pp., some text-figs., many photographs, 32 tables. 8″ × 5″.) Price, $3.80.

Part I of this book deals with various aspects of crop production, while Part II is concerned with production and management of the main crops and pastures. The text has a strong American background, but gives an entirely new approach to the study of this phase of agricultural production. The suggestions to teachers and students in the authors' preface and at the end of each chapter are very useful. Emphasis is placed upon the development in the students of an appreciation of the importance of efficiency in crop production. This is a very important point, not usually sufficiently emphasized in other reference books on crops.

A very valuable chapter is that headed 'Growing Best-Adapted Crops'. The quotation from Alfred Vivian—'It isn't enough simply to grow crops, but they must be so produced as to yield a profit on the capital invested'—is very pertinent in our present-day horticulture in N.S.W. It is not only a question of growing the best varieties, but those varieties must be of the best-adapted crops.

The production of the chief crops is covered in a concise manner, the main cultural operations receiving due mention. Conservation of the soil receives its brief treatment, in conjunction with crop production. A pleasing feature is the very useful series of illustrations demonstrating machinery and methods not seen much in our country. At the end of each chapter is found a useful list of references.

On the whole, this is a very useful book. Its price in Australia will probably preclude its use as a text in our schools, but it should certainly find a place in the reference library.

S. Cook.

Bacteriology

Bacteriology, A Textbook of Micro-organisms. By Fred Wilbur Tanner and Fred Wilbur Tanner, Jr., 4th edition. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 625 pp., 137 text-figs. and photographs. 8½″ × 5½″.) Price, $4.50.

This book is intended primarily for students being introduced to the subject for the first time. The well achieved aim of the authors has been to impress the importance of a general approach to bacteriology. In so doing they have omitted much thought-arresting detail, with the result that the book reads more like an entertaining novel than the more conventional texts; the contents are consequently more easily digested. In this respect the book is suitable as a background for normal lecture programmes.

Amongst the interesting topics discussed is a comparative approach to general systematic bacteriology, in which the authors have compared the characteristics of the animal and plant kingdoms and have outlined fairly clearly the position of the bacteria in relation to these. A section dealing with the more important aspects of bacterial taxonomy has been included. The book is printed in large clear type and the illustrations are generally good.

V. B. D. Skerman.

Chemistry

Organic Reactions, Volume IV. Edited by R. Adams. (New York: John Wiley and Sons, 1948. 428 pp., tables. 5¾″ × 9″.) Price, $6.00.

The appearance of a volume of *Organic Reactions* is an event greeted with much enthusiasm by most organic chemists. The fourth volume retains the high standard of its predecessors and includes the following chapters: The Diels-Alder Reaction, the Prepara-

tion of Amines by Reductive Alkylation, the Acyloins, the Synthesis of Benzoins, the Synthesis of Benzoquinones by oxidation, the Rosemund Reduction of Acid Chlorides to Aldehydes and the Wolff-Kishner Reduction.

It is unnecessary to mention the aims and objects of this series, but perhaps one criticism may be of help to the editor. In every chapter a paragraph or two is devoted to the mechanism of the reaction. This, of course, does not give the author much scope, but the reviewer suggests that what is given should be either historical and/or the most popularly accepted theory. This is not always the case; in the chapter on the benzoin condensation it would appear that probably the most important part of the reaction, a proton transfer, has been overlooked.

In the chapter on the Wolff-Kishner reduction the 'remarkable deacylation of cuskhygrine' is mentioned. As it has been shown recently at the University of Sydney that the formula used for the alkaloid is incorrect, the proposed mechanism is invalidated.

As for the previous three volumes the editors, authors and publishers are to be congratulated upon this most valuable acquisition to the literature of organic chemistry.

G. K. Hughes.

Vacuum Manipulation of Volatile Compounds, By R. T. Sanderson. (New York: John Wiley and Sons, 1948. 162 pp., 40 text-figs., 17 tables. 8½″ × 5½″.) Price, $3.00.

Chemical vacuum technique falls into two fairly clear-cut divisions which, although closely related insofar as the production and measurement of a high vacuum are concerned, yet involve the application of quite distinct methods. The category into which a given compound will fall is determined by whether its vapour pressure is substantial, i.e., greater than 1 mm. of mercury at room temperature, or whether it exerts only a negligible vapour pressure at ordinary temperatures. The methods accordingly divide readily into those dealing with working conditions mainly at or below normal temperatures on the one hand, and above normal temperatures on the other hand.

It is on the latter techniques, including such important modern operations as molecular distillation and vacuum sublimation, that attention has been focused in the past two decades, due in no small part to the pioneering researches of Hickman and his collaborators; whereas descriptions of the methods and apparatus involved in the former techniques have been largely dispersed among the experimental details of apparently unrelated chemical work. Dr. Sanderson in his book, subtitled 'a laboratory manual describing the application of high vacuum technique in experimental chemistry', has now assembled in a convenient form all the varied data necessary for the construction and operation of such apparatus. His book is accordingly concerned mainly with the use of vapour diffusion as a means of handling small amounts of volatile materials at working conditions at or below normal temperatures.

There are particularly well-written chapters on materials of construction and operation, glass blowing, and the production and measurement of high vacua. It is especially gratifying to note the inclusion of a very timely reminder of the commonly neglected toxic properties of mercury vapour, as originally pointed out by Stock. Other chapters cover the production and measurement of low temperatures, use of valves, measurement of volume and vapour-pressure, and details of the construction and operation of a general-utility high-vacuum apparatus. There is a useful appendix containing vapour-pressure/temperature data for use in the vapour-pressure thermometer, and a comprehensive collection of melting point, boiling point and vapour-pressure data at temperatures between −110° C. and 20° C. for 398 pure compounds, ranging from aluminium borohydride to zinc dibutyl. The usefulness of this table, unfortunately diminished by a somewhat arbitrary arrangement, especially of carbon compounds, could be greatly improved by the provision of a formula index, following a system such as that employed in *Chemical Abstracts*.

The book is written throughout in a clear and lucid style, and the text-figures are of uniformly high standard. Dr. Sanderson is to be complimented upon a volume which will undoubtedly fill a long-felt want in effecting an introduction to this important research technique.

J. Cymerman.

Engineering

The Measurement of Stress and Strain in Solids. Based on the Proceedings of a Conference arranged by the Manchester and District Branch of the Institute of Physics. Edited by F. A. Vick. (London: The Institute of Physics, Physics in Industry Series, 1948. 114 pp., 22 plates, 37 text-figs., tables. 6″ × 9½″.) English price, 12*s*. 6*d*. net.

This book is based on a series of papers read at a Conference, arranged by the Manchester and District Branch of the Institute of Physics in July 1946, on the measurement of stress and strain. During the last ten years the interest in this subject has grown considerably, due mainly to the increasing necessity for weight-economy and consequently for more accurate methods for the determination of comparatively high stresses existing in structural or mechanical components.

The book may well be divided under four main headings: (a) electrical-resistance strain-gauges, (b) photoelasticity, (c) strain measurement by X-rays, and (d) additional electrical methods of measurement of strain.

Of the papers in the first category, that by E. Jones on the physical characteristics of

wire-resistance strain-gauges is a particularly valuable contribution to the literature, since it gives a comprehensive account of the nature, magnitude and methods of reducing the many small inaccuracies which may occur in this type of gauge. The account is based on systematic investigations of a fundamental nature carried out at the Royal Aircraft Establishment. Dr. F. Aughtie also contributes a paper on the design of electrical circuits for separating and measuring various types of load when acting simultaneously on a member, by means of a number of resistance strain-gauges in combination. A simple example of this is the measurement of the axial tension in a rod in the presence of a bending moment. Of the two remaining papers, one deals with the possibility of using high-frequency alternating current of the order of 100 kilocycles per second as a means of increasing the magnitude of the strain-gauge signal, and the other gives an account of some Admiralty work on the use of resistance strain-gauges in ships.

There are three papers on photoelasticity: the first, by W. A. P. Fisher, being a survey of important recent developments in technique. He deals particularly with three-dimensional photoelasticity and with methods used for separating the principal stresses. The two other short papers are concerned with the photography of stress-patterns and with a method of inhibiting the growth of time edge-stresses in Bakelite BT.61-893, by the simple expedient of storing the model in a desiccator.

The main paper on strain measurement by the diffraction of X-rays from the atomic lattice gives an account of the basis of the method, and some useful technical hints. One is led, however, to the conclusion that considerable advances are required before this method can compete with others in practice, although it is the only known non-destructive method of measuring locked-up stresses in a material, in the 'as-received' condition.

The last two papers in the book deal with various other electrical strain-gauges, including acoustic, variable inductance and variable capacitance types. It would be more correct to describe each of these as 'extensometers', since they measure change in length over a given gauge-length, the sensitivity of the instrument increasing in proportion to this length. The characteristics of the associated electrical circuits, amplifiers and recorders are discussed.

The book should prove valuable and can be warmly recommended.

W. H. WITTRICK.

MICROWAVES AND RADAR ELECTRONICS. By Ernest C. Pollard and Julian M. Sturtevant. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 426 pp. 5½″ × 8¾″.) Price, $5.00.

The great advances in microwave and other radio techniques associated with radar which took place during the war have not yet been fully documented. Following the initial accounts in restricted reports and then in technical journals, the final integration in book form is proceeding and is yielding books of varying lengths. The most elaborate is the partially complete Radiation Laboratory series which offers encyclopaedic information in twenty-seven volumes to those who wish to read extensively. A book covering the radar field in one volume was recently published in Australia—*A Textbook of Radar*—by the staff of the Radiophysics Laboratory, Council for Scientific and Industrial Research*. The book under review attempts to cover essentially the same ground as the Australian book, in a slightly more concise form; in doing so it presents information restricted almost entirely to that from American sources.

The content covers the range of techniques associated with microwave radar in a well balanced manner. Introductory chapters on electromagnetic fields and waves are followed by sections on microwave generators and receivers, cathode ray tubes and time base circuitry, and servo-mechanisms and computers. The final chapters deal very briefly with applications of these techniques to radar, to communication, and to sundry research problems. The style is clear and at times rather breezy. We gather that the authors had first-hand experience of some of the subject matter, from remarks such as that relating to the vicissitudes of those who use Klystrons: 'Power is then applied to the Klystron, and the odds are that it does not oscillate'.

In certain sections, particularly the fundamental ones associated with the physical basis of radar, concise statement is associated with confused thinking. Thus in deriving the free-space radar equation the book states 'The antenna concentrates this power into a beam so that the power radiated in the direction of maximum intensity is greater than P_t (the transmitter power) by a factor G called the antenna gain'. It is, of course, the power-flux density in the optimum direction which is increased by the factor G, above that which would exist if the aerial were an isotropic radiator. This loose statement is immediately followed by a faulty definition of the scattering cross-section of an echoing object.

The final chapter dealing with the use of microwaves in various branches of physical research is stimulating, particularly the section outlining the physical principles of microwave spectra.

J. L. PAWSEY.

NEW ADVANCES IN PRINTED CIRCUITS. U.S.A. National Bureau of Standards, Miscellaneous Publication M.192. (73 pp., 48 text-figs., 6 tables. 7¾″ × 10¼″.) Available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price, $0.40.

* This JOURNAL, *10*, 190.

This publication is a record of the proceedings of the First Technical Symposium on Printed Circuits held on 15 October 1947, in U.S.A., under the sponsorship of the Aeronautical Board and Technical Direction of the National Bureau of Standards. In all, seventeen papers were presented describing the latest developments in the manufacture and fields of application of printed electronic circuit techniques. Quite apart from its general interest, the report contains considerable manufacturing detail and should prove very useful to anyone directly concerned with the development of these techniques in Australia.

F. J. LEHANY.

GAS TABLES. By Joseph H. Keenan and Joseph Kaye. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 238 pp., 64 tables. 7½″ × 10″.) Price, $5.00.

The Tables include a revision of those for air, published in 1945 and superseded by the present volume. For the revised Tables the authors have used an analysis, by Rossini and others, of data from other sources as well as those used for the former publication, *Thermodynamic Properties of Air.*

Properties of gas-mixtures resulting from the combustion of hydrocarbon fuels in an excess of air are tabulated on a molal basis (pound-molecule) and are found to give sufficiently accurate results over a considerable range in the proportion of hydrogen to carbon. Tables of constituent gases are also given. A third section contains extensive tables of flow and shock functions required for problems involving supersonic flow.

W. H. H. GIBSON.

Food

The following corrections should be made to the review published in This JOURNAL, *11*, 182-3, of the book on *Advances in Food Research*, Vol. I, by E. M. Mrak and G. F. Stewart. The words shown in italics indicate the corrections to be made.

In the text of the second paragraph, the article by E. C. Bate-Smith is 'with special reference to the ageing of *beef*'.

The article on processed potatoes is by *A. F. Ross*.

General

THE PACIFIC ERA. Edited by W. W. Davenport. (Honolulu: The University of Hawaii Press, 1948. 273 pp.)

The sub-title states that this is 'a Collection of Speeches and Other Discourse in Conjunction with the Fortieth Anniversary of the Founding of the University of Hawaii'. This prepares us for the general theme of the chapters. They are divided into three groups: *The Pacific Era*, in which the topics include 'Science and Men in the Pacific Era', 'Recent Social Trends in the Pacific', 'Technological Progress and the Pacific Society' and 'The Rôle of the University in the Pacific'; *Higher Education*, with such subjects as 'The Liberal Arts College in the Modern University', 'Education and the Public Service', 'What Now in European Education?', 'University Education in Great Britain and America' and 'Education in Old and New China'; *The Atomic Age*, with addresses on 'Freedom and Obligation in American Democracy', 'University Contributions to Foreign Policy' and other matters.

Obviously this is not a scientific book, but it contains many interesting observations, opinions and generalizations made by men of experience and note. Thus Karl T. Compton (Massachusetts Institute of Technology) outlines three objectives of a State University: (a) to lead in the education of the population, (b) to assist in the general economy by teaching the fundamentals of the sciences, and (c) to develop a social attitude which is creative and constructive. In this connexion the lecturer urged that students 'through their educational programme' be brought in frequent contact with leaders in the professions, in the industry, or in political thought. He suggested, too, that an industrial relations section is desirable in every university.

This book is a means of becoming acquainted with the ideas on higher education of leaders in American university life. One interesting exception is the descriptive address by F. G. Mann, Fellow of Trinity College, Cambridge, England, on 'University Education in Great Britain and America'.

A. P. ELKIN.

RESEARCH IN INDUSTRY. Edited by C. C. Furnas. (London: Macmillan; New York: D. Van Nostrand, 1948. 574 pp., 43 photos, 30 text-figs. 6″ × 9″.) English price, 36*s*. net; American price, $6.50.

This book has been compiled by the representatives of companies belonging to the Industrial Research Institute, Inc. (America). The list of authors contains many well known names; whilst it may be regretted that some of the major chemical manufacturers are not represented, undoubtedly the editorial board has had a difficult task in both providing a wide cover and limiting the authors to a reasonable number.

The complex position that research plays in modern industry is very clearly set out in this book. The surprising fact that emerges is the extraordinary degree of agreement between all authors on major principles. Whilst in details there are differences, there is a general acceptance of the opinion that industrial research, whether carried on by a small or a large organization, must be properly represented in the high councils of the company. There is also complete agreement on the fact that research personnel must be of the highest standard, selected from the best available research graduates of the universities with, if possible, advanced research training. Whilst a case can often be made out for a brilliant exception, the general rule is to start off with the best qualified personnel that can be obtained. Having employed men of high

calibre, the company then accepts the responsibility to see that proper facilities are provided to enable the research worker to operate efficiently.

A strong point made by many of the authors is that it must be clearly recognized by all that a company exists primarily to pay dividends and that the research department should be equally conscious of this fact. These authors recommend that periodic statements should be issued showing the returns earned by the research department. A warning note is sounded against the lavish expenditure of money on research by industry without due regard for the reasons for undertaking the work and the possible returns to be expected.

The research worker will be happy to read that the average expenditure in America on research is of the order of two to three per cent. of gross sales, and that in the chemical industry progressive companies consider three per cent. to be the minimum to maintain a lead over their competitors. A further matter of interest is that generally about fifty per cent. of new projects selected for research arise from the research department. The value placed on research by the du Pont organization is shown by the fact that in 1942 forty-six per cent. of gross sales consisted of products not manufactured in 1928. The research worker, however, will not be so happy to read the chapter on research reports and find the importance placed by industry on the proper reporting of all work and the significance of the laboratory note-book in patent policy.

Every reader engaged in industry or academic research will find much here to interest him, but it is sad to realize that the book is unlikely to be read seriously, if at all, by the body of men for whom it has the most important message, i.e., the senior executive. This message is clearly given in the following quotation:

> There need never be fear of government competition if industry develops a really worthwhile programme of research and recognizes that any producing enterprise is made up of four equally important integrated parts: finance, production, sales and research. Without any one of these components, no business can live for long.

For those readers who wish to pursue the subject matter of the book in greater detail, an excellent list of references is given. There is a place for this book in the scientific libraries of all industrial and academic institutions.

O. E. Finn.

Geology

Physical Geology, 3rd edition. By Chester R. Longwell, Adolph Knopf and Richard F. Flint. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall Ltd., 1948. 602 pp., 365 text-figs. 9¼″ × 6¼″.) Price, $5.00.

With a striking dust-cover showing Paricutin in eruption, this third edition of a standard text-book of physical geology used in many American colleges is well printed and bound, such as is usual with books published by John Wiley. An especially attractive feature is the wealth of very good illustrations, particular use being made of aerial photographs.

The treatment of the subject is simple and designed to meet the needs of a person with no knowledge of geology. The usual chapters outlining various aspects of the subject are present, the authors stressing the processes, both internal and external, by which land forms are developed. Probably the best chapter is No. 2, in which movements of the Earth's crust, and isostasy in the formation of geosynclines and the deposition of sediments, are discussed in an interesting and, to the new student, most informative manner.

A list of reading references, each with a short comment, follows each chapter; appendices give brief information about minerals, rocks, topographic maps, and a time-scale of Earth-history. It is obvious that the book is intended to be used in conjunction with other text-books and with a laboratory course in the identification of rocks and minerals; for one cannot reasonably discuss processes unless one is familiar with the materials on which such processes act. *Physical Geology* adequately covers the usual Australian university first-year course, and with local illustrations could be used with advantage. As a teaching aid the publishers will supply, at additional cost, a large set of Kodachrome slides showing geological features (largely from American sources) that illustrate nearly all aspects of the subject.

Dorothy Carroll.

History of Science

A Source Book in Greek Science. By Morris R. Cohen and I. E. Drabkin. (Source Books in the History of Sciences series. New York: McGraw Hill, 1948. 579 pp., many text-figs. 5¾″ × 8¾″.)

The study of the steps by which, over the centuries, scientific ideas have become clarified and precisely formulated from out of a mass of confused observation and speculation, to say nothing of sheer magic, is a fascinating one, and one which perhaps yields place in interest only to the study of modern scientific ideas as they come thick and fast from living scientists.

Recognition of the interest and importance of the history of science and of its value in teaching scientific concepts to students in all stages of their scientific education has increased greatly during recent years and has given rise to the publication of many books in the subject. Among the more important of these books are those belonging to the series of Source Books in the History of the Sciences, to which the book under review is the latest addition: the other books of the series already published are a Source Book in each of Astronomy, Mathematics, Physics, Geology. The general aim of the Source Books is to provide the student and teacher with information

about the history of science which he would find hard to get otherwise, and the point of view adopted is that it is best to let the makers of science state their ideas in their own words.

In the book under review the authors have made their selection of extracts from Greek science with insight and discrimination; and they have given, in the discoverers' own words, a well balanced picture of Greek science covering a period of about a thousand years. The extracts which make up the body of the book are taken from Mathematics, Astronomy, Mathematical Geography, Physics (including Mechanics), Chemistry and Chemical Technology, Geology and Meteorology, Biology, Medicine and Physiological Psychology. Where treatises on special subjects already exist (e.g., on Conics) the authors have included only a few extracts of special historical significance, wisely leaving the reader interested in these topics to consult the larger works. In appropriate places throughout the text there are short prefatory notes to particular topics, copious explanatory footnotes, and many diagrams and illustrations. The latter, especially, show the versatility of Greek scientists.

A close study of the first four sections indicates that the authors have included extracts on all of the topics one would expect to find (and one assumes this is true for other sections which the reviewer is not competent to assess). For example, in Geometry the authors give a few paragraphs on the history of Greek geometry down to Euclid, and then give extracts from the writings of Greek mathematicians. The latter are upon Analysis and Synthesis in Geometry, with one example; the postulates, with a critical note by Proclus on the parallel postulate; the Method of Exhaustion; special theorems such as that of Pythagoras; the three famous problems of Greek Geometry (the squaring of the circle, the duplication of the cube, the trisection of an angle); Conic Sections.

No less interesting than the extracts illustrating ideas that have survived the test of centuries (as is true of most of the ideas in Geometry) are those which illustrate ideas and explanations which have had to be modified or rejected subsequently. We can admire the ingenuity of many of these early explanations, and we may even almost regret that they are no longer tenable! For example, a random opening of the book (at p. 384) reveals the 'Explanation of Earthquakes' taken from Aristotle's *Meteorologica*, II, 8, which tells us that:

> The severest earthquakes take place where the sea is full of currents or the earth spongy or cavernous; so they occur . . . where the sea is supposed to flow in channels below the earth . . . A great and therefore violent wind is developed which would naturally blow away from the earth: but the onrush of the sea in a great mass thrusts it back into the earth . . . Our theory has been verified by actual observation in many places. It has been known to happen that an earthquake has continued until the wind that caused it burst through the earth into the air and appeared visibly like a hurricane. This happened lately near Heracleia . . . Here a portion of the earth swelled up and a lump like a mound rose with a noise: finally it burst, and a great wind came out of it and threw up live cinders and ashes . . . Indeed, this must be recognized as the cause of the fire that is generated in the earth: the air is first broken up in small particles and then the wind is beaten about and so catches fire.

The book is strongly recommended to teachers of science in schools, technical colleges and universities, both for the personal enjoyment and profit they will get from it, and for the help which it and the other books of the series can give them towards enlivening their lessons and lectures.

I. S. [T]URNER.

SCIENCE AND ITS BACKGROUND. By H. D. Anthony. (London: Macmillan, 1948. 291 pp. 8″ × 5¼″.) English price, 10*s.* 6*d.*

The author is well qualified to write a popular book on his subject, having been headmaster of a large grammar school, lecturer in Mathematics, scholar of Queen's College, Cambridge, and Chief Inspector of Army Education. One of his principal interests has been the relation of science to history.

The aim of the book is to give something of the story of science, together with the background of history in which that story is set. To achieve this, two features have been introduced. Firstly, most of the chapters are centred on the work of individual men of science, selected not merely as a part of scientific history, but because of the value of their work today. Secondly, the historical background is not only that of isolated biography, but continuous history of human affairs. Dr. Anthony in his preface refers to the metaphor used by Sir Richard Livingstone, of a rope by which man has climbed to his present position, the three strands of this rope consisting of action, knowledge, and vision. The three are interwoven, and in this book the strand of knowledge, as developed by men of science, is not separated from that of action, as represented in history, or that of vision, in the realm of ideals; and the true relationships between these are indicated in a series of seven charts.

The author sets out to state simply, within the limits of a small volume, some of the achievements of science as a whole in relation to the background of history, the progress of European civilization, and the life of today. After an introduction dealing with geological time and human history, the subject matter is grouped under the following headings:

the Rivers Period — Beginnings of Science;
the Mediterranean Period—Classical;
the Mediterranean Period—Mediaeval;
the Atlantic Period—Modern;
the World Period—International Conflict;
the World Period—World Co-operation.

Within the limits he has set himself, Dr. Anthony has provided the general reader with

a broad foundation on which to base a fuller appreciation of the debt of mankind to science.

The book is clearly printed; in addition to the charts referred to there are some 100 illustrations and diagrams.

H. R. Carne.

Mathematics

Nomography. By A. S. Levens. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 176 pp., 117 text-figs. 6″ × 9″.) Price, $3.00.

Professor Levens, of the University of California, has provided a useful elementary text and handbook in principles of the design of nomograms. It replaces a text compiled in 1937 under the title, *Alignment Charts*. The layout is notably clear and spacious; the exposition is simple; and the development of each theoretical principle is immediately followed by well-chosen worked examples. There are, in all, 127 further exercises offered to the student at appropriate points, chosen from relations which are common in engineering, chemistry, physics and statistics. Twenty-nine interesting and useful charts, also, are given as completed examples in an appendix. Not only is there a chapter on 'Practical Short Cuts', but the whole book is written with an eye to practical application of clearly-expounded theory. More explicit advice might be welcome, however, on some aspects of choice between alternative types of chart.

The theory is developed only by the geometrical method. A concluding chapter introduces the use of determinants, and should interest the student in further study of this more general and more flexible method; but it might well have gone farther towards such a desirable end, if it were to be included at all. The book itself goes as far as curved scales and net charts. A bibliography of eighteen titles is included. As is bound to happen when a selection is made from a wide extension of basic forms, different readers would prefer different selections—the reviewer, for example, regrets the omission of circular charts as applied to trigonometrical equations. A few misprints and minor errors were noted.

R. L. Aston.

Physics

Atomic Energy. By Karl K. Darrow. The Norman Wait Harris Lecture at The Northwestern University. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 80 pp., 13 text-figs., 3 tables. 5½″ × 8½″.) Price, $2.00.

Introductory accounts of nuclear energy have hitherto followed the romance of successive research developments, and have been enlivened by word-pictures of physicists and by ideas of present and future applications. The four lectures published by Karl Darrow, of the Bell Telephone Laboratories and Secretary of the American Philosophical Society, are somewhat more sophisticated in approach, being designed to explain only the essentials of present knowledge. Free from constraints of chronology, and from wanderings in minor bypaths, Darrow can deal more effectively with his selected concepts. The lectures, though for non-physicists, were for a university audience, and so are not notably superficial. Incidentally, they give the scientist-reader an opportunity of improving his perspective of contemporary research.

The author is sometimes at pains to defend himself against possible criticism regarding his simplifications (such as requiring for his particular purpose no distinction between mass and weight, nor a conception of any but sphere-like sub-atomic particles); but he nevertheless endeavours at some length to make his audience understand the concept of energy, as fundamental to the whole subject; and he demands thought upon the nature of physical units before he proceeds to mass-defect. As to the degree of complexity required by a conscientious scientist in an exposition of such character—and, indeed, the intelligibility of science in general—he believes that 'we ought not to hasten any faster than we are driven', and that 'at any moment of time we should enjoy the maximum of simplicity compatible with that moment'. In science he distinguishes three types of secrets—those reserved by man-made authority, such as the size of bomb components; those reserved for initiates after years of arduous preparation, as in quantum mechanics; and those still kept by Nature, such as the factors by which the common heavy elements retain nuclear stability.

Rutherford and Fermi are the only two men whose work is distinguished by name. Again, there are only two pictures given of events in the research background—the culmination of Fermi's pile at Chicago, and the symbolic significance of Rutherford's students 'staring into the darkness at ghostly evanescent flickerings'. (The significance of Einstein's discovery of the $E = mc^2$ relation in 1905 is also discussed in relation to present-day selective suppression of publication of research.) The text is, however, enlivened by continual metaphor and other imagery; particles falling under the sway of short-range attraction attain their 'heart's desire'; a transmuting nucleus 'adjusts itself to its desire'; the path of a radioactive tracer is marked as the path of an advancing army would be in the night 'if each expiring soldier were to set off a flare at the instant of his extinction'. On the other hand, Darrow protests strongly against the adoption of the term 'atomic' for *nuclear* phenomena, as in his own title, instead of reserving it for chemical phenomena and the like; and he similarly protests against the term 'atom *smashing*' as applied merely to the changing of partners in a dance.

The first lecture reaches the proton-neutron structure; the second relates mass changes to

the simpler transmutations; the third reaches nuclear fission; the fourth explains conditions of chain reaction and proceeds to general radioactivity. Several cloud-chamber pictures are used as illustrations. It is unfortunate that a book of such character and standard should include a few numerical mistakes (as on pages 41 and 59) which might confuse the careful lay reader.

R. L. ASTON.

Public Health

PUBLIC HEALTH ENGINEERING. Volume 1. By Earle B. Phelps. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 655 pp., 137 text-figs. 5½″ × 8½″.) Price, $8.50.

This book which, in accordance with the sub-title, is a text-book of the principles of environmental sanitation, is compiled by the Professor of Sanitary Science at the University of Florida. In 1924 Professor Phelps published, under the title of *Principles of Public Health Engineering*, a series of lectures given at Columbia University. Since that time considerable advances have been made in sanitary science and public health engineering and the present work is intended to cover the whole field of public health engineering as understood today. The public are becoming conscious of many factors which in modern highly industrialized areas are responsible for deterioration in general public health, e.g., pollution of waters used for domestic supply or waters for recreational purposes, pollution of streams, pollution of the atmosphere, contamination of foodstuffs. This book surveys the problems, discusses the results of investigations already carried out and points out how the various health risks can be minimized or removed.

After an introductory chapter, 'Man and His Environments', which surveys the present position of the science of public health engineering, the book is divided into two parts, one dealing with the air contact and the other with the water contact. Some well-known specialists have assisted in the preparation of the text of the various sections. In the first part (the air contact) there are chapters covering all aspects whereby health may be affected by factors usually associated with the air, e.g., weather and climate, air supply, thermal environments of the human body, ventilation, lighting, atmospheric pollution, noises, insects and insect control. The second part (the water contact) is covered by chapters on hydrology, water quality, water supply, sewage disposal, stream pollution, treatment of polluted waters and rural sanitation.

Each section is dealt with completely and, although reasons are given for various remedies, the details of method of construction are left to the reader to develop. The author states in the preface 'it is written primarily for the engineer who presumably has learnt how to design and build, to teach him, in the light of present day knowledge of sanitary science, what to design and build and why . . . Its approach is through chemistry and the biological sciences, especially bacteriology and physiology. It stresses public health engineering rather than engineering itself.'

Although the information, data, etc., are mainly from American sources and may not apply to present Australian conditions, it must be emphasized that as Australia becomes more densely populated (as it must if it is to survive), and consequently more industrialized, the conditions in many parts of Australia will become more like those at present in the U.S.A.

The book, which contains a vast amount of information, much being thought-provoking, will be invaluable to public health engineers, public health medical officers, health inspectors and to all those who have some interest in public health matters. Research officers will find reference to a considerable amount of investigation which has been carried out in other countries.

T. B. NICOL.

Veterinary Science

ANIMAL BREEDING. Fourth edition. By Lawrence M. Winters. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 404 pp., 155 photographs and text figs. 9″ × 6″.) Price, $4.50.

This new edition of a well-known text-book on a subject of foremost economic importance to Australia warrants very careful consideration by teachers, students and livestock breeders. Before embarking on the reading of it, the reviewer jotted down his own ideas as to what subject matter might be covered in a book with such a broad comprehensive title, keeping in mind the needs of college students and breeders. This resulted in a table of contents that proved to differ only in minor features of sequence from the author's plan. The previous edition had promulgated ideas of improvement in livestock breeding based largely on established genetic principles. The extensive experimental work with farm animals carried out in the United States during the past two decades has enabled the author, in this volume, to fortify his ideas with valuable research data.

The first ten chapters cover, in a necessarily brief manner, a rather wide field of subjects, including some broad economic and historical material, anatomy and physiology of the sex organs and endocrine glands, fertilization and development. Elementary genetics is treated rather too briefly, considering that genetic principles provide the basic framework on which breeding theory is built. This book, then, should be supplemented with a standard book on the fundamental principles of heredity. The applied subjects, however, are given ample consideration and include a very good chapter on lethal genes. The book is of high

merit in the sections devoted to the practice and problems of the constructive breeder. The presentation of experimental data, and the modern concepts arising from them in such subjects as selection, inbreeding, cross-breeding, the role of pure-bred stock and fertility, is just what the student of breeding wants.

The author contributes a very full and clear chapter on artificial insemination. Some of our veterinarians might think this beyond the legitimate scope of a book designed for students of livestock breeding, but they would find this up-to-date review of the subject invaluable in their own work. In any case, many of our leading breeders will be glad of the opportunity presented to study the techniques involved and to assess for themselves the value of the process in livestock improvement. The book ends with a valuable chapter on constructive breeding under the suggestive title 'Building Superior Germ Plasm'. The author draws heavily on his own improvement projects and provides valuable blank forms designed to facilitate the recording of breeding data.

This edition can be recommended for college students and progressive breeders of all classes of livestock. Its great value lies in the fact that it presents relevant biological principles and modern ideas of livestock improvement, which are based largely on the research work on animal production that has been made possible by the resources of the great American Experiment Stations.

G. F. FINLAY.

Zoology

COLLEGE ZOOLOGY. Fifth edition. By Robert W. Hegner. (New York: The Macmillan Co.; London: Macmillan and Co., 1947. 817 pp., 441 text figs., 8 coloured plates. 6½″ × 9¼″.) English price, 25*s*.

The late Professor Hegner's book is of interest because of its very wide scope. Although written as an elementary text-book, the work attempts to combine descriptions of a wide range of type-animals with an extensive review of the classes from which they are drawn. There are, in addition, comprehensive separate accounts of the functional processes, and some sound chapters on genetics, ecology and the history of zoology.

The invertebrates are dealt with fully, and on the whole well, especially the protozoa—as one would expect from the author's research experience of this group. On the other hand, the treatment of the vertebrates does not fully convey that idea of the evolutionary modification of form and function within the group which is usually regarded as a primary aim in vertebrate teaching. This is the consequence of omitting many precise conceptions of homology, and a surprising amount of the classical comparative anatomy.

The treatment of vertebrate embryology also suffers from the omission of much of the material required for fruitful comparative work, such as the results of modern studies on gastrulation, and an adequate account of the development of the hen's egg or other heavily yolked egg. To offset these omissions, the radiation of form and habit within the separate classes is well described and profusely illustrated. In this respect the new edition has been substantially improved by the incorporation of several coloured plates, which are designed to illustrate the biological significance of various colour patterns.

The accounts of physiology and ecology are comprehensive and useful. It is unfortunate, however, that the information which they contain does not always provide for an adequate physiological and ecological knowledge of the anatomical types described in the systematic section. For example, there is no adequate account of the mammalian oestrus cycle in the chapter devoted to reproduction.

The worth of Hegner's *College Zoology* as a potential text-book must depend very largely on the perspective of the teacher, but, at the least, it may be recommended as sound collateral reading, which would be of benefit to any student at the elementary stage.

ALASTAIR G. WILLIS.

A TEXTBOOK OF ENTOMOLOGY. By Herbert H. Ross. (New York: John Wiley and Sons; London: Chapman and Hall, 1948. 532 pp., 434 text-figs. 6″ × 8″.) Price, $6.00.

This book differs very little from the large number of previously published entomological text-books, except that it includes, under one cover, brief elementary discussions on all the major aspects of the subject. It would, therefore, be useful as a preliminary course of reading for a student who had no access to any other literature. The references are meagre and refer mainly to other text-books, and very little recent work is included, so that the book is not of much value to the advanced student, who would do better to consult the standard text-books on particular aspects of the subject. The general arrangement is attractive, and the book is abundantly illustrated, mainly from previously published text-figures.

A. R. WOODHILL.

Book Notices

ANIMALS ALIVE. By Austin H. Clark. (Toronto-New York-London: D. Van Nostrand, 1948. 472 pp., illustrated.) Price, $4.00.

A vast range of animal forms is covered in a popular manner. The value of the book lies not so much in the direct description of factual observations as in the thought which the author provokes upon various relationships. He interests the reader not only in the effect of man upon nature but in the effect which the domestication of animals has had upon man's culture and history. Food habits make entertaining reading; extraordinary relationships between animals are pointed out; and attention is drawn to upsets in the balance of nature, past, present and potential.

The book is discursive not only in style but in structure. Its four main sections are entitled Man and the Animal World, Land Animals, Fresh-

Water Animals, Sea Life; but choice of chapter-subjects is mixed between taxonomy, habits, distribution and other characteristics. Illustrations are not referred to in the text and fail to give a balanced illustration of the text. Various inaccuracies include a major error concerning the prenatal nourishing of marsupials, denying any form of placentation whatever. On entomology, besides serious errors, there is a perpetuation of discredited theories. On birds, there is a fantastic account of brush turkeys laying eggs in sand of beaches; and the statement that the emu is actually an ostrich!

Animals Alive is a somewhat rambling account of zoology from the viewpoint of an individual: it shows the breadth of his personal experience and the intimacy of his wide professional contacts.

THE HUMANITIES AND THE SCIENCES IN DENMARK DURING THE SECOND WORLD WAR. (Copenhagen: Ejnar Munksgaard, 1948. 723 pp.) Price, 60 Danish Crowns; postage, 3.46 D.Cr.

A survey of the development in all fields of science in Denmark during the German occupation. A compilation of 150 papers by specialist authors, grouped in 24 sections, with a subject index. As well as the usual pure and applied sciences, the subjects include bibliography, philosophy, theology, political science, history and philology.

WHO'S WHO IN THE AGRICULTURAL INSTITUTE OF CANADA? 1948. (Ottawa: Agricultural Institute of Canada. 226 pp. 6″ x 9″.) Price, $2.50.

The biographies of over two thousand agricultural scientists at present employed in the scientific institutions of Canada; including personal details, past and present positions held, and major official activities.

STRESS ANALYSIS AND DESIGN OF ELEMENTARY STRUCTURES. Second edition. By James H. Cissel. (New York: John Wiley and Sons, 1948. 419 pp., 223 figs., 40 tables, 8 design charts.) Price, $5.00.

An outline of structural analysis, with illustrations of application and design, suitable for architects and others who may not desire full engineering thoroughness. The new edition includes a chapter on light-gauge steel construction, which deals with elastic stability. Most of the design charts and data apply only to American materials.

AUSTRALASIAN HERBARIUM NEWS, No. 3, September 1948. Published half-yearly by the Systematic Botany Committee of Section M of the A. and N.Z. Association for the Advancement of Science. (46 pp., typescript quarto, paper covers.) Obtainable from Miss N. T. Burbidge, Division of Plant Industry, C.S.I.R., Canberra, A.C.T.

William Hartley writes on Systematic Botany in Eastern South America, which he has visited. J. B. Cleland contributes a detailed review of Black's *Flora of South Australia*, Part II. Correspondents discuss the standardization of plant names; isolated descriptions of new species; presentation of data in taxonomic papers. Seven pages are devoted to extracts from the Report of the British Intelligence Objectives Sub-Committee on *The State of Taxonomic Botany and Botanical Collections in Some Areas of Germany since 1939*. This is followed by eleven pages of titles of botanical literature published in Germany in war years, and thirteen pages of new species of Panerogams listed in German publications. There are several pages giving news of botany and botanists in Australia and New Guinea.

EARTH WALL CONSTRUCTION, III, Stabilized Earth. By G. F. Middleton. (Dept. of Works and Housing, Commonwealth Experimental Building Station, Duplicated Document No. 19, 1948. 14 pp., typescript, 4 photo-figs. in 2 plates. Foolscap, paper covers.) Obtainable from the C.E.B. Station, Ryde, N.S.W. Price, 1*s.*

This is a brief and very elementary description of the stabilization of soil for earth wall construction. Only the two normal methods are considered, namely, by Portland cement and by bituminous emulsion.

CLIMATE AND HOUSE DESIGN—THERMAL CHARACTERISTICS OF BUILDINGS. By J. W. Drysdale. (Dept. of Works and Housing, Commonwealth Experimental Building Station. Duplicated Document No. 27, 1948. 20 pp., typescript, 2 tables. Foolscap, paper covers.) Obtainable from the C.E.B. Station, Ryde, N.S.W. Price, 1*s.*

As a result of temperature surveys of houses under Australian conditions, a method is proposed for estimating the difference between internal and external temperature of buildings of different types of construction. Frequencies of hot days in selected Australian towns are given in an appendix.

SECOND INTERIM ANALYSIS OF THE STRENGTH OF MASONRY WALLS. By David V. Isaacs (Dept. of Works and Housing, Commonwealth Experimental Building Station, Special Report No. 1, 1948. 59 pp., typescript, 9 figs. set in 3 plates, 26 tables. Foolscap, paper covers.) Obtainable from C.E.B. Station, Ryde, N.S.W Price not stated.

A somewhat hypothetical mathematical analysis of walls of block masonry loaded with a uniform lateral pressure per unit area. The walls considered have return walls at each end and may contain door openings and window openings. The stresses in the blocks and in the joints are estimated. This Special Report replaces the former Duplicated Document No. 14.

A supplement gives a list and summary of all Bulletins and Duplicated Documents published by the Station.

BUILDING RESEARCH, 1940-1945. D.S.I.R. (London: H.M.S.O., 1948.) English price, 3*s.* 6*d.*

This publication covers six years in which no annual reports were issued by the Building Research Board of the D.S.I.R. Many of the war-time problems dealt with by the Building Research Station were of immediate interest only, while others were outside the field of building research but were adapted to the Station's experience and equipment. Civil defence research included anti-scatter treatments for windows; glass substitutes; and fire protection. Other problems included the testing of existing road bridges for excess over design-loads; remedial and design measures involving soil mechanics; development of a high-temperature process for manufacturing phosphate fertilizers; concrete jigs for aircraft fuselages; and the manufacture of alumina.

Post-war reconstruction programme first required the issue of Notes advising upon the repair of damaged buildings, then a series of 'Post-War Building Studies' was issued under the sponsorship of the Ministry of Works. The Building Research Board appointed committees to deal with subjects such as heating and ventilation, plumbing, fire grading, acoustics and sound insulation. Some of the resulting publications have sold more than 30,000 copies. By 1945, research was proceeding upon building materials, methods of construction and the efficiency of buildings. At this stage a programme of construction of houses was inaugurated to enable full-scale trials of ideas. The publication includes a full summary of the 1945 work, as a report of the Director of the Research Station.

TREATMENT AND DISPOSAL OF INDUSTRIAL WASTE WATERS. D.S.I.R. (London: H.M.S.O., 1949.) English price, 12*s.* 6*d.*

During the 35 years since the last book on this subject was published in Great Britain, there has been a growing realization of the importance of maintaining water resources and many advances have been made in methods of treatment. The book describes results of work in many parts of the world, with particular reference to that of the Water Pollution Research Laboratory set up in 1927 by the D.S.I.R.

The earlier chapters deal with the effects of industrial effluents on waters used in industry, on domestic supplies and on fisheries. Following chapters deal with general methods of treating industrial wastes and sewage, particularly the more recent biological methods. Each of the remaining chapters deals with waters from particular types of industry—such as coal and ammonia pollution; metallurgical pollution (including chromates and cyanides); and raw-material pollution (textiles, tanning, paper, milk, slaughtering, fermentation, fruit, etc.).

Comparative results of various methods are presented in tabular form. A list of references is given at the end of each chapter.

TYPES OF ROAD SURFACING AND MAINTENANCE USING TAR OR ASPHALTIC BITUMENS. D.S.I.R., Road Note No. 5. (London: H.M.S.O., 1948.) English price, 1*s*.

The results of research and the development of new products have produced a bewildering variety of bituminous binding materials, in various grades of volatility, differing in consistency from very fluid materials which pour at atmospheric temperature to hard materials which are only slightly indented by a needle. Choice of materials is determined by both economic and technical considerations. A guide to the purposes and technical merits of various types of construction, written for non-specialists, is offered in this publication.

PROPERTIES OF ROAD TARS AND ASPHALTIC BITUMENS IN RELATION TO ROAD CONSTRUCTION. British D.S.I.R., Road Research Technical Paper No. 12. (London: H.M.S.O.) Price, 9*d*.

A summary of available information for the student or engineer who wishes to understand the complex properties that cause one type of surface to behave differently from another—such as the viscosity of the binder, its adherence to the aggregate, and its resistance to decomposition by weather.

CONCRETING AND BRICKLAYING IN COLD WEATHER. British D.S.I.R., National Building Studies Bulletin No. 3. (London: H.M.S.O.) Price, 6*d*.

Commencing with a brief account of the effect of frost on newly placed concrete, the bulletin discusses the methods of (a) using simple precautions for average winter conditions; (b) using calcium chloride; (c) using special precautions for urgent work in severe weather. Useful tables are included. The methods described are those developed in America.

FLAX RETTING WITH AERATION. British D.S.I.R., Water Pollution Research Technical Paper No. 10. (London: H.M.S.O.) Price, 3*s*.

Prior to 1940, British flax factories produced flax of coarse fibre by 'green scutching', but not the fine fibre which results from retting. Attempts to adopt the aerobic process of retting used in Europe met with the difficulty that existing factories were so situated that the large quantities of very polluted water produced were objectionable. The Paper describes the investigation which produced a process of aerating the water during retting, so that the same water may be used in successive rets throughout a season.

Other lines of research are described, including attempts at chemical coagulation, which were unsuccessful, and attempts at biological filtration, which proved costly and difficult. Alternative lines of research in aeration are also described. Much information was obtained on the bacteria responsible for retting. Aeration oxidizes away the organic matter accompanying bacterial growth, whereas the anaerobic process converts it into acids. Conditions in the flax stems themselves, however, are still anaerobic, and the organisms mainly responsible for retting, even under conditions of considerable aeration, are found to be spore-forming anaerobes.

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(Continued from This JOURNAL, *10*, 193, June 1948)

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The Australian Journal of Science

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The Australian Journal of Science

Volume 12, Number 2

OCTOBER 1949

THE AUSTRALIAN NATIONAL RESEARCH COUNCIL

Science House, 157 Gloucester Street, Sydney

Registered at the General Post Office, Sydney, for transmission by post as a periodical.

Edited
by
R. L. Aston

AUGUST 1949
Volume 12
Number 1

The Australian Journal of Science

CONTENTS

Published Six Times a Year

Annual Subscription: Ten Shillings
Price per issue: Two Shillings

The Australian National Research Council, Science House, 157 Gloucester Street, Sydney

Edited
by
R. L. ASTON

OCTOBER 1949
Volume 12
Number 2

The Australian Journal of Science

CONTENTS

Published Six Times a Year

Annual Subscription: Ten Shillings
Price per issue: Two Shillings.

The Australian National Research Council, Science House, 157 Gloucester Street, Sydney

Edited
by
R. L. Aston

DECEMBER 1949
Volume 12
Number 3

The Australian Journal of Science

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Published Six Times a Year

Annual Subscription: Ten Shillings
Price per issue: Two Shillings

The Australian National Research Council, Science House, 157 Gloucester Street, Sydney

Edited
by
R. L. Aston

FEBRUARY 1950
Volume 12
Number 4

The Australian Journal of Science

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Published Six Times a Year

Annual Subscription: Ten Shillings
Price per issue: Two Shillings.

The Australian National Research Council, Science House, 157 Gloucester Street, Sydney

Edited
by
R. L. ASTON

APRIL 1950
Volume 12
Number 5

The Australian Journal of Science

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Published Six Times a Year

Annual Subscription: Ten Shillings
Price per issue: Two Shillings.

The Australian National Research Council, Science House, 157 Gloucester Street, Sydney

Edited
by
R. L. Aston

JUNE 1950
Volume 12
Number 6

The Australian Journal of Science

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Published Six Times a Year

Annual Subscription: Ten Shillings
Price per issue: Two Shillings.

The Australian National Research Council, Science House, 157 Gloucester Street, Sydney

The Australian Journal of Science

VOL. 12 — 22 August 1949 — No. 1

Goethe as a Scientist

To his 200th Anniversary, 1949

H. D. BRASCH*

UNLIKE Dante and Shakespeare, who really shaped the type of Modern Western Man, Goethe,† as a poet and sage, was not so much formative of this type as rather reflecting it, as it were, in a last colourful sunset. Yet although Goethe is known to the world at large mainly as a poet and writer, his activities were divided almost equally between Arts and Science. Like Leonardo da Vinci, he is better known for his creative works; but it is in his science that he, like Leonardo, was a forerunner of future developments. One of the last universal Europeans, he was surprisingly formative of the fundamental scientific attitude of the times to come after him.

Goethe's approach to the Natural Sciences, which fascinated him during most of his lifetime, was marked by the significant transition from the medieval-renaissance to the modern concept of Nature. It is useful to define, at the start, his place in the development of that concept.

Whilst the Greeks had seen Nature and Mind as one organic unit creating and moving itself in a way which ultimately cannot be explained, Christianity conceived the Universe as created and moved by a supreme Being standing outside and above it. Nature was thus thought of as *natura naturata*—as made and ruled by an external (transcendental) God according to his imposed laws. It became almost something like a mechanism that had been rationally engineered and could therefore be rationally understood and interpreted. This rigid, static picture underlies the doctrines of scholastic Christianity and St. Thomas Aquinas. As it encountered, during the Renaissance, the newly aroused interest in physical science, it resulted in the correspondingly static theories of Descartes, Newton and Classical Physics.

The Renaissance, however, brought also a revival of the Greek idea of *natura naturans*, creating itself ever anew by inner (immanent) energies. Once more, the Deity was conceived as being identical with that vast living organism which is Nature, dynamic, evolutionary, not explicable rationally in its ultimate urges and origins. This line leads via Christian mysticism to Giordano Bruno, Spinoza, and Modern Physics.

It was this latter idea of Nature which became productive in Goethe. It was his passionate experience of Spinoza's work which decided his attitude to Nature. God is Nature, from which Mind and Matter emanate; the union of both is Life and Reality, which can never be explained, and thus remains the great mystery before which Goethe never ceases to stand in awe. This wondering was Goethe's Nature-worship, it was the religion he confessed: 'to enquire into what can be enquired into, and to worship in silence what cannot be investigated'.

The table shows in a very simplified form Goethe's position in the development described.

Goethe's interest in science was first aroused in the free atmosphere of the ducal court at Weimar, where he first breathed the air of countryside and woodlands. It needed the clear contours of the Italian landscape, however, to make him wide awake to objective reality and to crystallize his ideas. The sight of a broken sheep's skull in Venice, of some plant in the gardens of Palermo, ignited his visionary thoughts of the development of bones, organs, or whole organisms from an archetype, the '*ur*'- (arche) plant or '*ur*'-animal.

His works dealt with Mineralogy, Geography, Metereology, Light and Colours, Botany, Zoology and Physiognomics. He maintained collections of natural objects and geological models; half a million of his own fortune was spent by him 'that I might learn what I know today (1830); in addition my salary and large literary income over more than fifty years; and more than another million and a half went through my hands which were spent for great objects by my princes'. Research was

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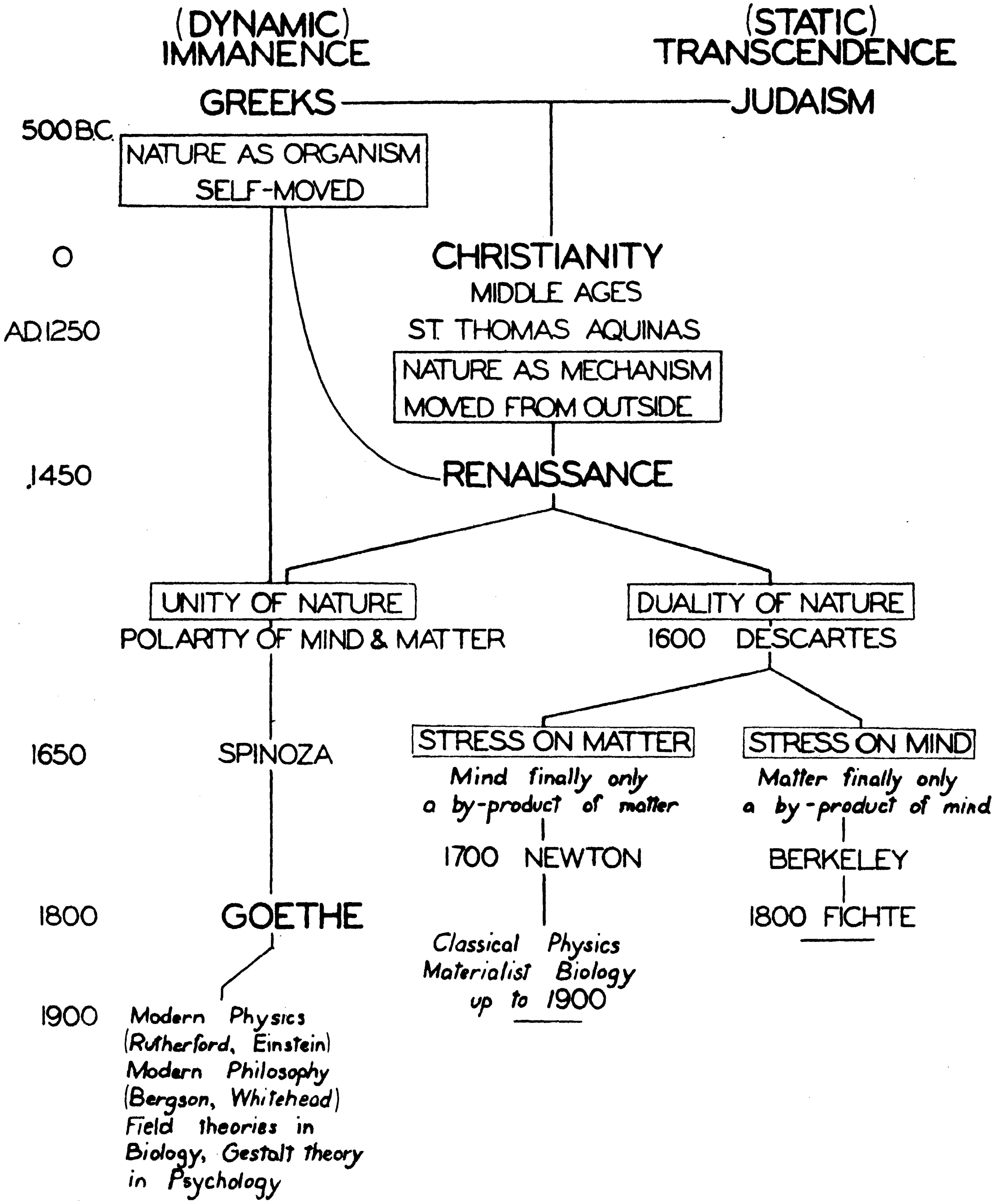
† J. W. von Goethe, born Frankfurt, 28 August, 1749; died Weimar, 22 March, 1832.



thus by no means just a sideline of his activities.

He attempted the natural sciences in nearly every department. Still, his tendencies were always confined to such objects as could be perceived directly by the senses. Hence also his scientific work was the 'great confession', as were his poetry and writing; everywhere he proceeded from personal experience and practical application to fundamental insight:

from hunting to Forestry and Botany, from the finding of a strange crystal to Mineralogy and Mining. He praises the concrete honesty of the natural sciences in preference to research in pure philosophy or pure history, which lead 'the one towards scholastics, the other towards revolutions'. For us today, perhaps, one remark is most interesting—the Humanities, he felt, were dead, covered with dust. 'It is fortunate that Nature has intervened to attract our interest, and to re-open, from her side, the way to Humanity' (written about 1810), and 'without my attempts at Natural Science I should never have come to know Mankind as it is'.

We see here quite clearly the two mainsprings of his Faust-tragedy: the insatiable thirst for knowledge of Part 1 of that play; and the hope to come nearer the riddle of Life by practical work on a concrete nearby object, the theme of Part II. And why does he wish to live another fifty years, says he as an octogenarian in 1830? Not to witness any big mystery solved, or any sublimation of mankind, but to see three canals built: the Rhine-Danube Canal, connecting the North and the Black Sea; the British in possession of a Suez Canal; and the United States of a Panama Canal.

Whereas concrete perception, instinct and imagination are the sources of his research, its aim is the wholeness of Life. But Life is change, and thus his main interest was in the nature of living organisms, their formation and transformation. This stress on change results in his morphologies of plants and animals; where he develops, by comparative research, archetypes from which by intrinsic forces of transformation all other forms sprang, and he proceeds from the observation of certain atrophied bones to prove evolution. Could not Darwin have written the following sentence? 'Nature could not have made a horse if all other animals had not been made before on which Nature, like on a ladder, climbed to the structure of the horse.'

For *morphē*, the shape or form, he chooses the modern word *gestalt*—so familiar to us today: it is 'the complexity of the existence of a real being'. These *gestalts*, however, are nowhere at rest, nowhere closed or final. They change incessantly, they flow from formation to transformation. Each of them comes from a sequence and points to a sequence; it is only one link of a great productive ascending chain. We touch here on a fundamental aspect of his ideas on Nature. Two main principles, he says, can be found everywhere in Nature: that of *Polarity* and that of *Intensification.* Transformation held in bonds by the inertia of what once has become reality, is one example of polarity; it accounts for the relative constancy of the species. His works abound with such examples of systole and diastole, of contraction and dilution, 'the greatest extension in the fruit, the greatest concentration in the seed', 'no matter without mind' and *vice versa*: an everlasting attraction and repulsion, and an everlasting ascent, an urge for more and more intense and complex forms, visible in mechanical, organic, and spiritual; in accidental, chemical and ethical phenomena.

His truly modern approach can be seen best in his method. To ask *Why?* and *What For?* is not scientific at all, he asserts. The only question permitted is *How?* We err when we seek for cause and effect. Both together form the indivisible phenomenon. Hence he rejects also the idea of teleology in Nature. In all these points he was the pioneer of modern physics and cosmology.

Goethe was predominantly a visual type. The eye was the very organ of his artistic and scientific activities. Early attracted by the world of colours, he devoted many years to his Theory of Colours, in which he expounded for the first time many physiological facts well known today: complementary colours, contrast effects, after-sensations on the retina, psychological effects of colour schemes, much as they are expounded in present-day industrial psychology. His physical theories have been abandoned, and his violent polemics against Newton's optics have been charged, for a long period, entirely against him. Modern thinkers, however, like Whitehead and Collingwood, criticize Newton's approach to fundamental problems in just the same way as did Goethe. It is known today that Newton himself was deeply disappointed in his own theories, optical and others, later in his life. 'And it is legitimate to infer that the careless and secondhand thinking on fundamental questions proved his undoing in the end' (Collingwood, *The Idea of Nature*).

The true issue between Goethe and Newton was deeper: it was really the fight between Spinoza, the monist, and Descartes, the great divider of the Universe into dualist categories. It was the controversy between the vitalist Goethe, for whom all reality was motion and process, and between the static world of the Newtonian bodies without duration, acting on each other through empty spaces. It was ultimately the war between synthesis and analysis.

To deal analytically with isolated material, to specialize by using elaborate instruments, physical (microscopes or telescopes) or mental (mathematics), seemed futile, even sinful, to Goethe. The reduction to numerical magnitudes destroyed, for him, quality and values in the empirical perception which is the source of all physical research: he anticipated those problems which begin to confront modern physical science, and have resulted, so far, in an intensified use of specialized semantics in nuclear physics, chemistry, and cell biology.

For him, Nature, Man, and Art was One Entity. Man and Mind were parts of Nature. Every observation was conditioned and modified by the observer: 'man cannot say anything about Nature without saying something about himself'; that is the new sense of Man's relation to Nature which he brings into our age. Always starting from the single experience, his universality rather protected him from, than tempted him to, striving for totality. He never tried to erect a system into which everything would fit. The pale cast of thought and speculation was abhorrent to him, and proudly he says of himself:

Wie hast du es denn so weit gebracht?
Mein kind, ich habe es klug gemacht:
Ich habe nie über das denken gedacht.

How is it that you were so successful?
My child, I have been clever:
I have never thought about thinking.

Nature and Mind are one, the subject and object in research are one: they all merge into the only reality we can deal with, the '*phänomen*'. 'This must be studied with love and care; one should investigate it with all possible precision, and see how far one can proceed with understanding and practical applicatfon; and one should leave the problem itself untouched.' For the phenomena are not problems to be solved as in algebra. They are forms, patterns, *gestalts*, to be beheld and grasped in quality rather than in quantity. In the highest and purest cases they are real and symbolic at once. They then present themselves to us as the last perceptible entity, as the '*urphänomen*', before which (as in the *epoptica*, the highest stage of the Eleusinian mysteries) any further analysis is impossible and would be only destructive. 'Here Deity itself is manifest; the scientist should leave them in eternal splendour and repose, the philosopher should accept them into his realm: here all questions cease; in front of them, we feel a kind of awe, almost anguish. The highest that Man can attain, is awe and astonishment; if the *urphänomen* causes this, let him be satisfied: more it cannot give, and he should forbear to seek anything further behind it; here is the limit.' 'One must not seek anything behind the phenomena, they themselves are the meaning!'

Goethe's concept and interpretation of the Universe are those of our present leading scientists and cosmologists.

He has initiated that tremendous swing from mechanist to organic and vitalist approach which characterizes modern science. His emphasis on concrete thinking can be felt in Medicine, where we no longer cure the disease but the patient, asking not so much what kind of disease the person has as what sort of person the disease has. His emphasis on dynamic thinking has helped to discard empty space and durationless bodies in physics, replacing them by fields of forces for ever in action and motion. Field theories have conquered in Biology and Morphology, formation and transformation being the main topics of their research. The *gestalt* theory dominates Biology as well as Psychology, where the idea of archetypes has been taken up by Jung. And comparative research has really started only since Goethe.

Modern physics no longer ask for cause and effect. Mind and Matter are no longer separate categories but polar aspects of one sole reality. All reality is process, implying permanent motion and change; hence a Space-Time continuum with the emphasis on Time. 'Nothing is done', says Goethe in refuting the ether theory, 'by assuming an ether for the motion of light, because ultimately everything

is life and motion, and we cannot perceive them except by their moving and thus, by contact, inducing the neighbouring object to motion'. These, however, are exactly the ideas of Bergson in *L'Evolution Créatrice*, and of Whitehead in *Process and Reality*. The activities themselves *are* the organisms; the primary particles already act and suffer, gifted with minute minds and urges; and every molecule, every cell, is in permanent hormic (desirous) development, desirous of realizing a *gestalt*, and attracted towards that realization by an eternal lure towards perfection which might be called Deity: thus Whitehead. This striving proceeds in discontinuous jumps. Matter, Life, Mind or Energy show different tendencies, gradually receding from simple mathematical symmetry; and a 'continuous progress from one realm to the other is nowhere and by no means to be found', says Goethe. 'There is an Idea underlying the whole by which Nature in Deity, Deity in Nature, acts through all eternities. Perceiving, beholding, reasoning, bring us nearer to those mysteries.' This concept, with Deity as a symbol for an asymptotic goal of all evolution, is precisely that held by Alexander and, again, by Whitehead. And our generally-accepted idea of Man as the present peak of the creation as known to us finds its expression in Goethe's words: 'For what is all that expanse of suns and stars and galaxies and nebulae, of worlds born and nascent, if not that in the end a happy man enjoys spontaneously his life?'

A universal mind like Goethe's, averse to dogmatic rigidity and closed totalitarian systems of thought, cannot avoid contradictions: they are the very manifestations of universality, and we even find the crudest contradictions in those religions, philosophies, and political theories which pride themselves on their catholic span. Goethe himself has forestalled, in a sort of mystical finale, objections of that kind: 'All is equal, all is unequal; all is useful and useless, salutary and noxious, sounding and mute, rational and absurd. And what we confess of single phenomena is often contradictory.'

But contradiction is motion, challenge; is Life: and we are at the beginning of a new cycle.

The Use of Radio Waves for Astronomical Observations

J. L. PAWSEY.*

Radio waves are used in making astronomical observations in two ways: using 'echoes' as in radar, or using the waves spontaneously emitted by the astronomical bodies. The first method has been applied to meteors and the Moon; the second to the Moon, Sun and our Galaxy. These observations and the resulting conclusions are described in general terms.

1. Introduction.

In recent years a radical innovation has been introduced into astronomical observing techniques. Radio waves are now being used for observing astronomical phenomena. They provide a supplement to light, which, if we include the infra-red and ultra-violet ranges, has provided almost the whole of the present data of astronomy. The newly applied radio-waves are not different in kind from light. Both are transverse electromagnetic waves, but the radio waves are enormously greater in wavelength. A typical light wavelength (green) is 5×10^{-5} centimetres and a typical radio wavelength utilized in astronomy is five metres: the ratio between these is 10^7. An indication of the wavelength ranges of the electromagnetic spectrum is given in Figure 1(a). The wavelength difference between light and radio waves is associated with important differences in generation and propagation which promise that radio waves should yield information supplementary to that given by light.

The most obvious difference is that radio waves can be directly generated by changing electric currents, so that these waves can be used to detect naturally-occurring electric currents or oscillations of masses of electrons. A familiar terrestrial example of this is the location of thunderstorms by means of the atmospherics which originate in lightning flashes.

Thermal Radiation at Radio Frequencies

The emission of light and heat differs from the above process in that radiation of random phase is emitted from individual atoms. Such emission is not restricted to wavelengths of light but extends over the whole spectrum. Thermal radiation in the radio-frequency range originating in this manner is unfamiliar to us because the usual power levels are minute compared with those of common radio signals or interference. The sensitivity of a radio receiver, however, may readily be made sufficient to detect and measure thermal radiation, provided it is not masked by other stronger radiation. A measurement of the temperature of the Moon's surface by means of thermal radiation is described later. The emission of such radiation is precisely analogous to the emission of light by an incandes-

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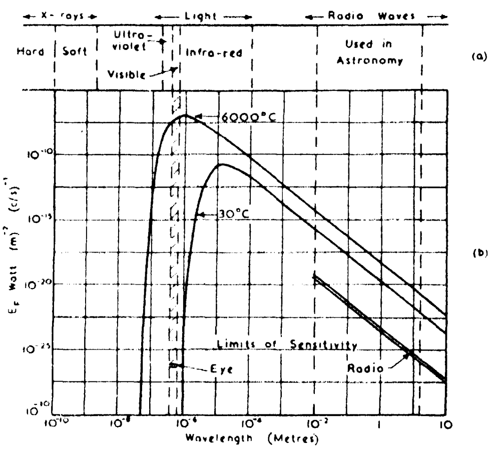

Figure 1.
(a) Approximate wave-length ranges of light, radio-waves, etc., in the electromagnetic spectrum.
(b) Distribution of radiation in the spectrum of 'black-bodies' at temperatures of (i) 6,000°C. and (ii) 30°C. (E_F is the power emitted per unit surface area per unit frequency range of the spectrum, expressed in the practical, m.k.s., units usual in radio measurements.)

cent body. The intensity of the radiation conforms with the standard laws of radiation.

Differences between the intensity of emission of light and of radio waves are illustrated in Figure 1(b), which shows the spectral distribution of emitted power for black bodies of 6,000° C. and 30° C. These temperatures are approximately those of the surfaces of the Sun and Earth respectively. The spectra are computed from Planck's law. The curves give the total power per unit frequency band (not wavelength) emitted by one square metre of surface of an ideal 'black body'. The scales are logarithmic and greatly compressed, the emission and wavelength scales covering ranges of 10^{25} and 10^{10} respectively. The optical and radio ranges of wavelength are shown. Indications are given of the limits of sensitivity of observation in each range under ideal conditions. Because the observing instruments in the two ranges have such different properties, uniform conditions for the limits cannot be specified in the two cases. The optical limit is based on an assumed ability of the eye to detect 100 quanta, originating in a wavelength range spread over one-third of the visual spectrum. It is also assumed that one-third of the light from one square centimetre can enter the eye. The assumption in the radio case is that the black surface extends over the whole field of view of the aerial. For the higher temperature, light has the advantage of exceeding the limit of detection by a larger factor; but for the lower one, it is seen that radio emission is appreciable while, as is well known, the light emission is negligible.

Thermal emission from bodies which are not 'black bodies' follows the usual laws identifying a good emitter with a good absorber. Absorbing regions therefore not only impede the passage of radiation through them, but contribute their own radiation, of an intensity which depends on their temperature and degree of opacity. The first obvious difference between the absorption of light and of radio waves is a simple extension of the tendency exhibited by infra-red light to penetrate haze. Radio waves of wavelengths greater than a few centimetres penetrate clouds freely. This permits radio-astronomical observations in cloudy weather which would preclude optical ones. A more important source of obscuration, however, promises to be overcome: in interstellar space there are huge clouds of obscuring dust or smoke which are evident in particular cases as great dark patches along the Milky Way. These prevent optical observation of a great part of our Galaxy.

A second difference is that radio waves are reflected or absorbed by ionized gases of adequate electron-density, though these are effectively transparent to light. The guiding of radio waves around the Earth by the ionized regions of the upper atmosphere, known as the ionosphere, is a terrestrial example. The outer atmospheres of the Sun and stars are much more extensive ionized regions, which will be opaque to radio waves from inside and will themselves emit waves.

The range of radio wavelengths used in astronomy is from about one centimetre to a few tens of metres. Longer wavelengths are prevented from reaching the Earth by the ionosphere, and shorter ones by absorption in atmospheric gases due to very long infra-red absorption bands. Over most of the range between these wavelengths the atmosphere is almost completely transparent, more so than it is to light.

Methods of Observation

Two entirely distinct methods have been used in radio astronomy: the 'echo' method of radar, and the 'natural radiation' method. The principles of radar are sufficiently well-known to require no description here. Because the echo method involves the spreading out of energy in space twice over—once in transmission from transmitter to target, and again from target to receiver—prohibitively large amounts of power would be required to obtain echoes from the more distant astronomical objects. This factor has limited the application of the method to nearer distances—to meteors, and to the Moon. Even with the Moon it is difficult to attain the necessary sensitivity, and in the recent Australian Moon-echo experiments the transmitter gave pulses each with an energy of 10^4 joules (10^5 watts for one-tenth second) as compared with a typical value for a high-power radar set of one joule (10^6 watts for 10^{-6} second). The sensitivity of a radar set depends, other things being equal, on the energy per pulse.

Observations of natural radiation are made by using a directional receiving aerial con-

nected to a sensitive radio receiver. The magnitude of the 'signal' picked up on the aerial is indicated by a meter connected to the output of the receiver. The aerial may be turned to different directions to determine the intensity of radiation arriving from different directions in space. There are, of course, sources of terrestrial radiation, man-made or natural, to confuse the observer; but radiation from outside the Earth may be identified if it can be shown to come consistently from a fixed direction in space. Such an instrument cannot give a picture of an area in the sky as can a camera attached to a telescope, but is limited to a single reading for a given direction, as is a photo-electric exposure meter. The field of view, corresponding roughly to the inverse of the resolving power of a telescope, cannot be made very small, because it is not feasible to use aerials which are very many wavelengths in aperture, and this introduces limitations due to diffraction. Usual fields of view are degrees or tens of degrees across. Measurements of angular position are therefore not attainable with anything like the precision possible using optical means. Special techniques, however, have been evolved to give accuracies of a few minutes of arc in favourable circumstances.

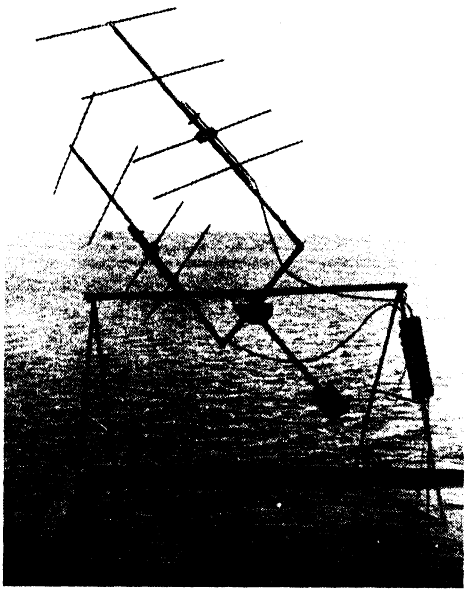

Figure 2.
A small aerial used on a wave-length of 3 metres. The two perpendicular sections are used for reception of circularly-polarized waves.

In contrast to angular precision, the power sensitivity attainable in radio measurements is remarkable. It would be possible, by integrating over only one second, to detect thermal radiation from a black body covering the field of view of the aerial, were the body at a temperature of a few degrees Absolute. This corresponds to a received power, in the case of a typical receiver of 1 Mc/s band width, of about 10^{-17} watts.

Equipment used at the Radiophysics Laboratory for the reception of radio waves from the Sun is shown in Figures 2 and 3. Figure 2 shows a small directional aerial used on a wavelength of three metres. The two sections having elements at right angles to each other were used, with appropriate phase delays, for the reception of circularly-polarized radiation. Figure 3 shows a larger aerial used on wavelengths between 25 and 150 centimetres. It consists of a parabolic reflector of wire mesh with a small collecting aerial at the focus—a surprisingly close analogue to the reflecting telescope used in astronomy. It is mounted, as is an astronomical telescope, on a polar axis. Associated receiving equipment is also seen in the box below.

2. Radio Waves from the Milky Way, or 'Galactic Noise'

The initial discovery of extra-terrestrial radio-frequency radiation was made by Jansky of the Bell Telephone Laboratories in 1932. In the course of studies of sources of interference with short wave, 15-metre, radio communications, he found a source which consistently appeared to come from the direction of the Sun. Observations over an appreciable fraction of a year showed that this direction was only temporarily that of the Sun, and was actually fixed in space. He drew the bold but logical conclusion that the radiation originated far beyond the solar system. He was further able to point out that the source shows a concentration in the plane of the Milky Way and a strong maximum in the direction in which the centre of our Galaxy is believed to lie. He inferred that 'the source of these radiations is located in the stars themselves or in the interstellar matter distributed throughout the Milky Way'.

The radiation does not show the 'crackling' characteristics of atmospherics, but gives a steady hiss in a receiver. Radio scientists use the word *noise* in a technical sense to describe random electrical fluctuations of this nature, and the radiation discovered by Jansky is often called *cosmic noise*, or, if we wish to refer to radiation associated with the Galaxy, *galactic noise*. Radiation in the radio-frequency spectrum from the Sun has similar characteristics and is often called *solar noise*.

Subsequent studies, notably by Reber, a young American amateur scientist, confirmed that the distribution over the sky conforms reasonably with what is known of the distribution of the Galaxy. This leads to the interesting probability that the galactic noise distribution may be used to determine the actual galactic shape, on the assumption that, whatever the nature of the source, it is distributed in a representative manner throughout the Galaxy. The shape of the Galaxy cannot be obtained directly from optical observations,

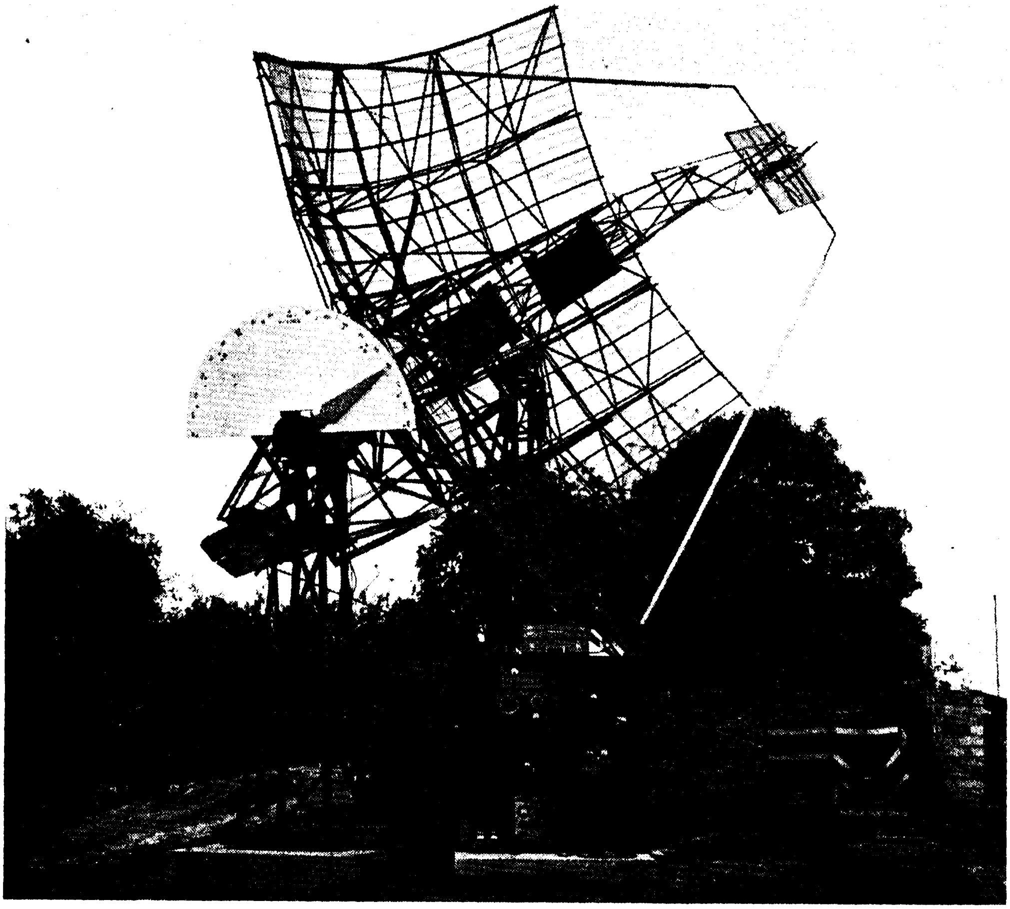

Figure 3.
A larger aerial, used on wave-lengths between 25 and 150 centimetres, consisting of a parabolic reflector with a collector at the focus.

owing to obscuration of the more distant parts by dust clouds in interstellar space, which may prove to be transparent to radio waves.

It is surprising that, at these wavelengths, the galactic radiation far exceeds that from the Sun; that is, radio-frequency 'star light' is brighter than radio-frequency 'sun light'. It is therefore clear that galactic noise cannot be due to the sum of effects from stars similar to our Sun. Reber attempted to meet this difficulty by suggesting an origin, not in stars, but in vast clouds of hot, ionized gas dispersed in interstellar space. These would be transparent to, and would not emit, light; but would be more or less opaque to, and so would emit, radio waves. This hypothesis remains unproven, but probably accounts for a substantial fraction of the radiation.

Radio Stars

Since Reber's suggestion was made, two new discoveries have suggested alternative means of origin. Firstly, the Sun was found to give enormous transient increases of radiation, so that it was suggested in 1946 that there may be stars on which processes similar to those which occur in the disturbed Sun yield radiation on an enormous scale. Secondly, a dozen or so 'point sources' of cosmic noise have been discovered by Bolton of the Radiophysics Laboratory over the past two years. These *radio stars* are not the bright optical ones. Three have been provisionally identified by Bolton with nebulae of peculiar characteristics, the rest have not yet been associated with visible objects. One of the former is identified with the 'Crab nebula', which appears to be the remnant of an exploded star which was observed as a supernova by Chinese astronomers in 1054 A.D. It now appears as a dim, nebulous object which is expanding with enormous velocity. A photograph of this nebula against its background of stars is shown in Figure 4. The distance of the Crab nebula is

Figure 4.
The Crab nebula, believed to be one of the radio-stars. It consists of an expanding envelope of gases thrown out by a supernova observed at this place in the sky by Chinese astronomers in the year A.D. 1054. (Photograph by W. Baade, Mt. Wilson. Taken from the book, *One, two, three . . . infinity*: George Gamow, 1947, The Viking Press, New York.)

estimated to be 4,200 light-years, which may be compared with 8 light-minutes for the Sun. Nevertheless the intensity of radiation from this nebula at a wavelength of 3 metres is of the order of one-tenth that from the undisturbed Sun. The ratio of the powers emitted at this wavelength by the Crab nebula and the Sun, assuming the inverse square law, is of the order of 10^{10}. This comparison may not be quite fair to the Sun, because its radiation occasionally increases very considerably, perhaps up to 10^{6} times. The mechanism by which these gigantic radio transmitters of space generate waves is not known but, at least in the case of an exploding star, there should be no difficulty regarding the amount of energy available for conversion into radio-frequency waves.

The total contribution of the known radio stars is only a small fraction of the total galactic radiation. Presumably improved techniques will lead to the discovery of more radio stars, but the present evidence suggests that there are sources of radiation, such as that suggested by Reber, in addition to these.

3. Radio Waves from the Sun, or 'Solar Noise'

Compared with the giant radio-stars, our Sun is a dwarf. Radio waves from the Sun do not appear to have been identified until 1942, when they were observed independently in England and America. During a few days in February of that year, English radar sets on about 5 metres wavelength were troubled by a peculiar form of interference. Observations of its direction of arrival were made. It was shown by Hey, a member of the Operational Research Group, that these directions consistently pointed towards the Sun, and he inferred that the interference was due to solar radiation. The radiation grossly exceeded the calculated value for 6,000° 'black-body radiation' from the Sun. There was a large sunspot visible on the Sun at that time. Southworth, of the Bell Telephone Laboratories, in the same year used newly-developed 3-centimetre and 10-centimetre radar receiving equipment in an attempt to extend the infra-red spectrum of the Sun to these wavelengths. He found steady radiation, corresponding in intensity not to 6,000° but to 18,000° 'black-body radiation'. These two observations, the one of a grossly varying component associated with sunspots, the other of a thermal component corresponding to a temperature somewhat greater than the 6,000° optical value, provide the clue to subsequent developments.

Variable Component

The variable component is prominent at metre wavelengths, and has been shown by the author and his colleagues at the Radiophysics Laboratory to be closely correlated with sunspots and to originate in small areas on the Sun's disk near them. These results were independently confirmed by Ryle and Vonberg in Cambridge. The correlation is not exact. Over the few years for which observations are available, giant sunspots have all been associated with intense radiation; but many smaller spots do not emit appreciably, and intense radiation has been detected in regions free from sunspots. Present ideas suggest that the radiation may originate high in the solar atmosphere, in masses of gas, which are so rarified that they may perhaps not be detectable optically. The visible sunspots and the radio emission would then be associated only as being each due to great disturbances in the solar atmosphere in the region concerned. Rapid variations in intensity, of the order of 10/1 in a few seconds, are a striking feature of the radiation. The more intense radiation, if it were of thermal origin, would frequently require temperatures of 10^{9} degrees and occasionally of 10^{13} degrees.

These values are far above anything known or suspected on the Sun, and, taken in conjunction with the rapid changes, have led to the conclusion that this component cannot be of thermal origin. It must be a manifestation of giant electrical disturbances in the solar atmosphere, a solar analogue of our thunderstorms. These disturbances are not yet recognized by optical observations, nor is the mechanism of emission of radio waves established. One of the interesting speculations concerning the origin of some of the largest

radio disturbances, which are called *outbursts*, is that these may be due to explosions on the Sun which hurl great masses of gas upwards, some with so great a velocity as to escape from the Sun. Incidentally, terrestrial magnetic storms and auroras are supposed to be caused by the arrival at the Earth of such masses of gas. In the Sun, these gases would move upwards and if, as is suspected, a particular wavelength of radiation is associated with each level in the solar atmosphere, we should expect to observe different wavelengths excited in succession. Some of the greatest outbursts have shown just such delays between the onsets at different wavelengths.

Thermal Component

Returning to the thermal component, the theory was independently presented in 1946 by Ginsburg of the U.S.S.R. and by Martyn of the Australian Council for Scientific and Industrial Research. On the basis of the electron densities and temperatures known from optical observations to exist in the highly ionized solar atmosphere, it was deduced that thermal radio-frequency radiation should originate in the upper solar atmosphere—the corona and chromosphere—rather than in the 6,000° photosphere, where the bulk of the light originates. The former two regions are believed to be at temperatures of about a million and 30,000° respectively, and it was concluded that intensities in appropriate wavelength ranges should be correspondingly high. The author and his colleagues were able to identify a steady component in the observed radiation which, over the wavelength range of 1 centimetre to 4 metres, could be identified with the thermal one. This work offers very direct verification of the surprising postulate that the kinetic temperature of the corona is of the order of a million degrees. Observations and computations based on a constant-temperature chromosphere agree poorly over the range of wavelengths of that part of the radiation, which originates chiefly in the chromosphere; and the next step has now been taken by Piddington of the Radiophysics Laboratory, in using the radio results to derive details of the distribution of temperature and density in this region. These details were previously deduced from difficult and inexact optical measurements supplemented by assumptions, so that they were very uncertain. Radio and optical data in this case provided complementary information which combined to give a direct answer. The broad outline of thermal emission by the Sun at radio frequencies is now well established. As we should expect for wavelengths which originate in the high solar atmosphere, the size of the emitting area is greater than the optical disk. In addition it is firmly predicted that, over a certain range of wavelengths, the radiation from the rim of the Sun should be more intense than that from the centre. If we had 'radio eyes', we should expect to see the Sun as a 'bright' circle with a less 'bright' centre.

4. Lunar Observations

The Moon is the one astronomical body to which both the 'direct radiation' and the 'echo' techniques have been successfully applied.

Observations of the emitted radiation on a wavelength of 1·25 centimetres have been described by Dicke and Beringer of the M.I.T. Radiation Laboratory, U.S.A., and by Piddington and Minnett of the Radiophysics Laboratory. There was no evidence for radiation other than simple thermal radiation from the surface of the Moon, and the results were interpreted in terms of average lunar surface temperatures. Reflected solar radiation is readily estimated and found to be trivial at this wavelength. The Australian observers carried out a series of observations extending over several months. They compared their observations with somewhat similar observations which had been made using infra-red light. Each series showed a regular oscillation of surface temperature as the visible face of the Moon turned towards and away from the Sun. The amplitude of oscillation of the radio temperatures, however, was substantially less than, and the phase retarded behind, that of the infra-red temperatures. The explanation given is that, whereas the infra-red radiation originates at or very close to the surface, the radio radiation originates over a range of depths of the order of half a metre. The temperature of the rocks at a depth would show a smaller variation and the phase of the oscillation would be retarded. Detailed consideration showed that in order to explain the results it was necessary to postulate a thin but very efficient thermally-insulating layer over the surface. It was suggested that this could be realized if a fine layer of dust covered the surface of the Moon.

Using the other technique, Moon echoes have been obtained on about 100 Mc/s by the Evans Signal Laboratory in the U.S.A.; by Bay in Hungary; and by Kerr, Shain and Higgins of the Radiophysics Laboratory, using the 20-Mc/s transmissions of Radio Australia. In this last experiment, standard radio transmitters and receivers were used, which have been available for many years in many countries. At this wavelength the effects of the ionosphere were expected to be appreciable and an object of the experiment was to study the effect of the ionosphere on signals which pass right through it. It is proved from the success of the various experiments that there can be no major absorbing region, effective at the wavelengths concerned, between the Earth and the Moon. No unexpected effects have so far been recognized. The Moon-echo technique may possibly find application in communication via the Moon between distant points, or, more probably, in ionospheric research.

5. Meteor Echoes.

The visual study of meteors is rendered difficult by their random and occasional occurrence. These difficulties are accentuated by

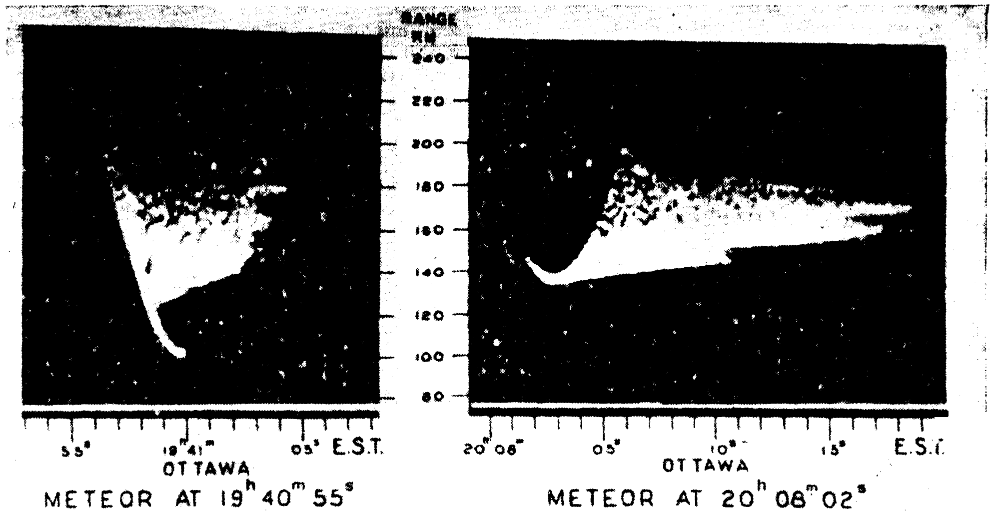

Figure 5.
Radar records of echoes from meteors obtained at Ottawa, 28 April, 1948, on a wave-length of 9·2 metres. The echo from the meteor itself is visible, first approaching and then receding. It is followed by an echo from an ionized region which persists many seconds after the passage of the meteor. (Reproduced from a paper by P. M. Millman and D. W. R. McKinley, 1948, *J. Roy. Astron. Soc. Canada*, 42, 121.)

frequent obscuration by clouds and by the impossibility of seeing all but exceptionally bright meteors by day. Consequently the introduction of a radio method of detection which operates equally by day and by night, and with or without clouds, offers interesting possibilities for the improvement of observations.

Meteors have been known to be a subsidiary source of ionization in the ionosphere for many years, but the use of the radio-echo method for the determination of numbers and directions of arrival dates from the end of the recent war. Hey and Stewart, who were then members of the English Operational Research Group, showed that transient echoes of duration from a fraction of a second to minutes, which were observed on 60-Mc/s radar sets, were due to visible meteors. In showers of meteors which come from one general direction, they were able to determine this direction from the radar observations. This work has been vigorously developed by Lovell and his school at the University of Manchester, and their extensive observations have led to the discovery of great meteor showers incident during daylight hours in summer in England. These were, of course, undetectable by optical methods.

A normal meteor is a particle a fraction of a millimetre in diameter. The direct echo from it at a distance of a hundred kilometres or so, the distance at which meteors are observed, would be far too small for observation. Similarly, the light emitted by the solid particle heated by its passage through the air would not be visible. The meteor, in passing through the air with velocity of the order of 50 Km/sec., causes ionization of the adjacent gas. This leads to the emission of light, which we see, and leaves an ionized column, behind the meteor, which diffuses outwards and finally disappears. The normal radio echo is from this column of ionized gas. Occasional meteors also give rise to rather mysterious weak echoes which appear to move with the meteor itself, so that the velocity of approach can be directly measured.

Radar records of the echoes from two meteors, obtained at Ottawa by Millman and McKinley, are reproduced in Figure 5. In these records the vertical scale is the distance from the observer, the horizontal one is time. The existence of an echo is indicated by a white part of the record. In each case a hyperbolic track is visible: this corresponds to the echo from the meteor as it first approaches and then recedes from the observer. It is followed in each case by an echo from the ionized trail, which endures for many seconds and then gradually disappears. The small white dots distributed over the record are instrumental and should be ignored.

6. Conclusion

We have followed the application of radio methods to the detection of phenomena ranging from the depths of space to the limits of our atmosphere. The resulting discoveries have depended on each of the salient features of radio waves: on the *transparency* of clouds of dust, on the *opacity* of ionized gases, on the

incandescence of material at low temperatures, and on the emission of radio waves by *electrical disturbances*.

Most of the progress in this branch of science has taken place in the four years since the war, and during this period a large proportion has originated in Australia at the Radiophysics Laboratory and the Commonwealth Observatory. Australian contributions were recognized in 1948 by the appointment of two Australians, Dr. R.v.d.R. Woolley, and Dr. D. F. Martyn, as chairmen of Commissions concerned with radio-astronomy, in the International Astronomical Union and the Union Radio Scientifique Internationale (U.R.S.I.), respectively. There is every reason to suppose that this new branch of science will make increasingly important contributions to astronomy and one hopes that Australian scientists will continue to play an important part in the work.

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Brillouin Zones and the Mathieu Equation

N. S. BAYLISS*

MANY of the features of the Brillouin zones of crystalline solids can be demonstrated conveniently in the simplified case of a one-dimensional lattice by making use of the properties of Mathieu's equation—

$$\frac{d^2y}{dz^2} + (a - 2\theta.\cos 2z), y = 0 \;\ldots\ldots\; (i)$$

It is known (Ince, 1932) that, if the solutions of this equation are required to have a period of π or 2π in z, the parameter a may have only certain values (denoted conventionally by a_0, a_1, a_2......; b_1, b_2, b_3 ......) which are functions of the parameter θ as shown in Fig. 1. In the special case of $\theta = 0$, $a_0 = 0$ and $a_m = b_m = m^2$ where $m = 1, 2, 3$....... As $\theta \to \infty$, a_{m-1} and b_m approach one another asymptotically. If the solutions of equation (i) are not restricted to the period of π or 2π in z, McLachlan (1945) has shown that convergent solutions are possible when the values of (a, θ) lie in the unshaded regions of Fig. 1. In the shaded regions the solutions are divergent and unstable.

We may now consider a one-dimensional crystal lattice consisting of N identical atomic cores spaced at equal distances l along the x axis (Fig. 2). The inner shell electrons are as usual supposed to be tightly bound to the nuclei and to be outside the scope of the problem. We therefore consider only the n valency electrons associated with each core. If the positive charge of the cores is first assumed to be distributed evenly throughout the one-dimensional lattice, the valency electrons are in a space of uniform potential energy as in the case of the simple Sommerfeld theory of metals. The positive charge may then be regarded as gradually segregated in the neighbourhood of the cores, producing a periodic potential field which we can write as—

$$V = k.\cos 2z \;\ldots\ldots\ldots\ldots\; (ii)$$

where $z = \pi x/l$. The variable z has the periodicity of π in the lattice spacing l, while V has a minimum at each core (see Fig. 2). (In a strictly one-dimensional lattice, V would become $-\infty$ at each core; but the potential function in (ii) is probably a closer approximation to the potential field in real lattices, where the valency electrons are largely between the nuclear planes.) The Schroedinger equation for the lattice—

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}(E \cdot k.\cos 2z)\,\psi = 0, \;\ldots\ldots\; (iii)$$

with the substitution $z = \pi x/l$, becomes

$$\frac{d^2\psi}{dz^2} + \frac{8ml^2}{h^2}(E - k.\cos 2z)\,\psi = 0; \;\ldots\ldots\; (iv)$$

which is identical with (i) if

$$\frac{8ml^2}{h^2}.\,E = a;\quad \frac{8ml^2}{h^2}.\,k = 2\theta \;\ldots\ldots\ldots\ldots\; (v)$$

The parameter θ of Mathieu's equation thus contains the constant k of (ii), while the eigenvalues of a give the energy levels E.

In the special case in which the valency electrons are assumed to be in a space of uniform potential energy, $k = 0$ and we have the well-known problem of Nn free electrons in a one-dimensional box of length Nl. The solutions of the corresponding equation,

$$\frac{d^2\psi}{dz^2} + a\psi = 0, \;\ldots\ldots\ldots\; (vi)$$

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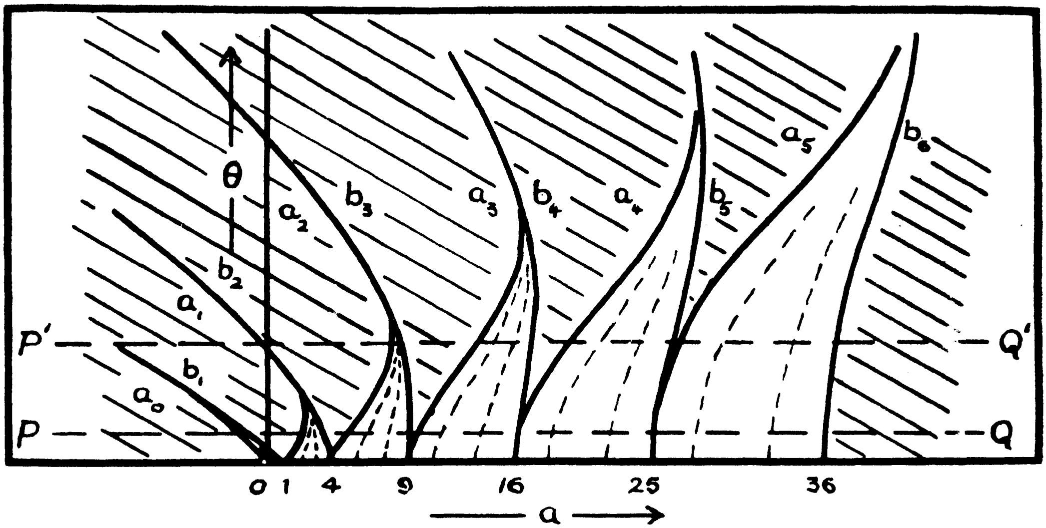

Figure 1.

must have nodes at the points $z = 0$ and $z = N\pi$. The eigenvalues of a are p^2/N^2, where p has the integral values 1, 2, 3....... There are N eigenvalues of a (i.e., N energy levels) in each of the intervals $a = 0$ to 1, $a = 1$ to 4, and so on. If the periodic potential energy of the lattice is now imposed on these electrons by gradually increasing k (i.e., by increasing θ), the eigenvalues of a will move continuously into the allowed regions of Fig. 1, while the number N of eigenvalues in each region remains unchanged. This situation is indicated by the dotted lines in Fig. 1.

The energy levels of the free electron gas thus become segregated into zones, each containing N energy levels (or $2N$ electrons in Fermi statistics), which are separated from one another by zones of forbidden energy. In the case of very large or infinite N, there are allowed bands of energy separated by forbidden energy regions. The following features of zone theory are immediately evident from an inspection of Fig. 1:

(*a*) For any given value of $\theta(k)$, the allowed zones become wider, and the forbidden zones narrower, as $a(E)$ increases. (See section PQ in Fig. 1.)

(*b*) As θ is increased (increased tightness of binding to the cores), the allowed zones become narrower, finally becoming single N-degenerate levels when θ is large enough. (Compare sections PQ and P′Q′ in Fig. 1.)

(*c*) Lattices whose cores have filled valency shells have filled zones, the highest of which is separated by a considerable energy gap from the next vacant zone.

(*d*) The simplest case of a metal with one valency electron per core ($n = 1$) has an incompletely filled zone with the consequent emergence of typical metallic properties.

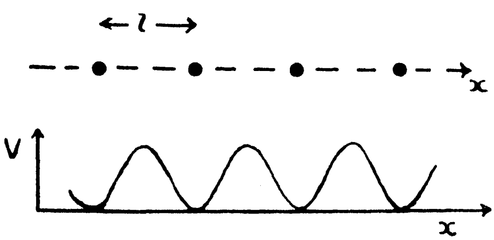

Figure 2.

Standard treatments of zone theory (Seitz, 1940) often emphasize the broadening and deepening of the discrete energy levels of individual atoms, as they are brought together with decreasing nuclear separation to form a lattice. The treatment outlined above approaches the problem from the different viewpoint of the gradual development of a periodic potential in a fixed lattice. The treatment is in no way dependent on assuming N to be very large or infinite, as in ordinary crystalline solids. It could be applied to complex molecules, such as linear conjugated polyenes, where the unsaturation electrons are subject to a periodic potential field and where N is comparatively small. In this connexion it is seen that the existence of continuous energy bands in the usual theory is a consequence of assuming N to be very large. In those cases where N is small, Fig. 1 shows that, while θ is increased, the individual energy levels are not broadened, but remain

discrete while they are gradually crowded together.

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Fishery Management and Changes in Abundance of Fish

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IN January 1947, an important meeting of North American fisheries biologists was held at Toronto. The proceedings have been reported (May 1948) under the title 'A symposium on fish populations' as vol. 11, article 4, of the *Bulletin* of the Bingham Oceanographic Collection (Peabody Museum of Natural History, Yale University). The volume has 283 pages, including 34 pages of valuable verbatim discussion on the nine papers presented. Some of the matters dealt with are highly controversial. One author, Burkenroad, suggested that 'the desirability of applying current theories of biological management to marine fisheries remains to be demonstrated'. Another, Langlois, asserted that these theories were actually inapplicable. Every fisheries biologist will want to consider such suggestions for himself. So, however, will others who may be less familiar with the present position taken by the science. The matter is also of potential interest to those conducting economic research on other animal populations. The writer therefore wishes to outline the current view of the contribution which science can make to the fisheries, and to discuss the validity of some of the comments made in the Toronto symposium.

The principal objective of aquatic biological research is to enable fishermen to catch, continuously, the greatest possible quantities of useful or pleasure-giving aquatic animals (mainly fish) for which there is a demand. (The stimulation of demand for species which are useful and freely available, but not appreciated by the public, is a separate problem which does not only concern biologists.) It is assumed that the fishermen have, or can acquire, the skill and equipment for the purpose. There are four ways of helping to realize the objective. Two of them make possible the exploitation of fish populations (stocks) which are new, either in the sense of creation by acclimatization or of discovery by exploration. Acclimatization has been moderately successful in inland and estuarine waters, but a failure in the seas. Exploration of the waters is still very important in some areas like Australia, which are large or sparsely populated. Largely because of these very features of such areas, however, the industry is often slow to utilize the newly-found resources. The other two methods may be applicable to fisheries that already exist. One involves the alteration (including possible restoration) of the environment, to increase its productivity in terms of the required fish. This has possibilities in reasonably small and circumscribed waters, where some elements of of the ecosystem can be controlled, but it appears to be valueless for the sea (Ricker, 1946; Cooper, 1948). The last line of attack, in its most optimistic formulation, is aimed at establishing a 'management' system for the fish stocks, whereby fishermen would be prevented from capturing more, but discouraged from capturing less, than a specified quantity from each stock in a given year. The amount might not be the same each year, but it would always be the maximum (optimum catch) that could be taken without directly causing a decline in the yield of any subsequent year.

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The management concept, in one form or another, at present dominates the thinking and activity of most fisheries biologists. Effort of this kind could still be fruitful when nothing practicable remained to be done along the other lines mentioned above. That stage seems almost to have been reached in some marine waters, e.g., the North Atlantic. The idea is based on the experience gained from investigations on natural fluctuations and overfishing, especially the latter, in individual fish stocks.

Both of these researches have been concerned with annual changes in number of fish or, more often, the total weight. It is convenient to use such terms as 'abundance' and 'scarcity' to cover both forms of expression. Sometimes the fish are intermittently scarce and abundant, often in quick succession, but there is a reasonable regularity in the amplitude and frequency of the fluctuations. It has been repeatedly shown that such changes occur independently of any human action (natural fluctuations). They are due to variable environmental factors, whose influence on the fish (nearly always on the young) is sometimes relatively favourable, sometimes relatively unfavourable, for their survival. Alternatively, the fish may become more or less continuously scarcer over a considerable period. In most instances where this has been investigated, there has also been evidence of an immediately preceding (and often continuing) intensification of fishing. This has naturally been regarded as the probable cause of the decline. Such a stock is said to have been 'depleted', as a result of 'overfishing'. Overfishing is any process of fishing that results in the total mortality losses, by the part of the stock that is useful to man, outweighing the accessions due to reproduction and weight-increase of survivors. A depleted stock can be restored by restricting the intensity of fishing. Unless the natural mortality rate is too high, this will permit the stock to increase significantly in

weight, and perhaps produce more young than before.

It follows that, if enough were known about the properties of a given population for reproduction, growth and survival under natural conditions, and their interaction—with one another and with fishing mortality at different rates—it would be possible to calculate the greatest catch that could be taken, consistent with maintaining a balance between total accessions and total removals. Natural fluctuations would tend constantly to disturb the balance; but, since they have often been successfully predicted, it might be possible to modify the estimates of optimum catch from year to year (Kesteven, 1946). The management system could then probably function as indicated above, subject to economic, social and administrative considerations in the choice of a control procedure (Herrington and Nesbit, 1943). The whole matter, however, is so complex that the optimum catch has yet to be worked out for any stock. If a depleted stock is being studied, the highest annual catch taken in the past, before the decline in abundance began, is an empirical measure of the optimum (Hjort, Jahn and Ottestad, 1933). It represents the surplus available to man under the conditions of the most favourable balance of the stock yet encountered, but not necessarily the best possible balance (Russell, 1942). It is not necessarily the same as the greatest known annual catch, which may be taken after abundance has begun to fall, if fishing intensity continues to increase.

The first paper in the symposium ('Fishing and assessing populations', pp. 5-25) is by A. G. Huntsman. It is mainly a plea for a very critical individual examination of supposed instances of depletion. Huntsman argues (*a*) that the apparent abundance-decline in a stock may not be real, (*b*) that even if real it may not be the result of overfishing, and (*c*) that even if it is, restrictions on fishing may not improve the position. His remarks on (*a*) and (*b*) are worth noting, although they are not original. A decline in catch per unit fishing effort, which is the usual measure of relative abundance, may indicate, not a smaller quantity of fish than before, but the same quantity divided among more units (*a*). This effect must always be present, temporarily, in the early developing stages of a fishery, when a large accumulated stock is available. It is generally realized, however, that the catch per unit effort is not a reliable measure of abundance at this stage in any case, because of changes in unit efficiency as the fishermen learn about the grounds and habits of the fish, and improve their boats and gear. If the fish really are scarcer, this may only indicate a long-term natural fluctuation in abundance, or in availability (as when the fish are in their normal abundance overall, but not where the fishermen expect to catch them), or despoliation of the environment by man. (*b*). There are circumstances in which certain forms of catch-restriction could fail to benefit a depleted stock, (*c*), but there is no such stock that could not be improved by an appropriate restriction. As indicated above, it would be useless to let the fish live longer for the purpose of adding more flesh, if such increment to the stock was all offset by natural mortality. There are, of course, two phases in the history of each year-class (brood) of fish composing the stock, an early one in which weight added by growth of individuals exceeds weight lost by natural deaths, and a later one in which it is less. The nett gain of the first is balanced, in nature, by the nett loss of the second. It is this balance which man fails to exploit fully when he is underfishing, by taking too few of the older fish; and which he upsets when he is overfishing, by taking too many of the younger as well as the older fish. Therefore, restriction of fishing could not fail to help to restore a depleted stock in the way suggested, if applied so as to conserve fish at the appropriate stage of their existence (Ricker, 1945). Huntsman is particularly sceptical about the need to conserve fish for reproductive purposes. All fisheries biologists would agree that a fishery will reduce the growth-by-weight of a stock long before reproduction is affected. This is because of the huge losses of young that occur even under the best conditions in nature, and because an inverse relationship between number of spawners and survival rate of young has often been observed (see below). Nevertheless there must come a stage at which the reproduction is reduced too, unless fishing intensity is stabilized first. When this is the case, restriction of fishing would obviously be beneficial.

Huntsman attempts to show that curtailment of fishing in the North Sea, during the 1914-1918 war, did not significantly restore the stocks of fish in that area. Many European workers have held that such benefit did occur in many instances, and similarly after the recent war, and this has been a powerful argument for restriction by regulation. Huntsman notes that the annual combined catch by weight of eight species was no higher after the war than before; but he includes the herring, which accounts for about 70 per cent. of the total figure, which has never been regarded as overfished, and for which the market demand is often well below the readily available supply. Trends in total catch are not very informative at best, but they are utterly useless as indicators of abundance trends, if there is not always a ready sale for the fish. As Huntsman offers no other evidence, his claim entirely fails.

The paper by T. H. Langlois ('North American attempts at fish management', pp. 33-46) is very provocative. Langlois claims to speak for a 'new movement' which attributes declines in abundance to long-term natural fluctuations rather than to overfishing. He believes that Lake Erie ciscoes have become scarce, not because of overfishing as previously claimed, but because of increasing water turbidity.

By restricting photosynthesis in the phytoplankton, this in turn might have reduced the production of the zoöplankton on which ciscoes feed. It does not appear that this is at present more than a hypothesis, and it was strongly challenged in the discussion that followed the paper; but that is not the most important point. It is the new attitude that is significant. Long-term fluctuations do occur in populations of marine animals, including fish (Kemp, 1938). Fisheries biologists have long realized that no one can with absolute certainty ascribe any fall in abundance to overfishing rather than environmental factors. Many of them, though summing up in favour of the former, have candidly admitted this difficulty. They have relied upon the evidence of the intensity of fishing, and have drawn attention to the risk of further decline in the event of this not being reduced. It has also been argued that even if, by a remarkable coincidence, the decline in question was due to natural change, the recovery of the stock would still be assisted, temporarily, by the same sort of restriction as that proposed to deal with the depletion (Clark, 1939). On the basis of such arguments, many fishermen have reluctantly accepted, or have been forced by administration to accept, restrictions which have often meant considerable initial hardship to them. It must be added that some biologists have not been sufficiently frank in admitting their inability to draw absolutely certain conclusions, and that the great majority of fisheries regulations have been imposed by administration without any assistance from science. Langlois is totally opposed to the idea that unregulated fishing has been an important factor in reducing fish-population size, or that regulated fishing can help to rebuild stocks. In his view, only the environment is important, and its alteration (in inland waters) represents the only way, apart from elimination of 'unnecessary restrictions', in which the fisheries can be improved.

The same argument is continued by M. D. Burkenroad, in a paper entitled 'Fluctuation in abundance of Pacific halibut' (pp. 81–123). The Pacific halibut problem has a special significance for fisheries biology, as it is regarded as the classic case of recovery of depleted stocks by curtailment of fishing, following very extensive research. Burkenroad analyses the data published by the halibut research organization (to which he does not belong) in respect of one of the two main areas of the fishery. His finding is that the stock decreased much faster, and is now increasing faster, than can reasonably be attributed to human influence in either phase. It is not the present writer's intention to discuss this work critically, and the halibut investigators will surely do so themselves in due course. It appears significant, however, that a former member of the halibut research team immediately conceded, in discussion, that the recovery of the stock could not have been wholly the result of the regulations. Burkenroad, therefore, inclines to the belief that human exploitation is of little or no significance in connexion with changes in fish abundance. He believes that such changes may represent major cyclic fluctuations involving decades. Recovery following restriction is to be explained by supposing that regulation will always be applied at about the period of minimum scarcity, following which the stock would begin to increase in any case. This would not, however, account for the recoveries that have twice taken place, following restrictions on fishing necessitated purely by war conditions, in certain European waters (Hickling, 1946).

W. E. Ricker and R. E. Foerster ('Computation of fish production', pp. 173–211) and Foerster ('Prospects for managing our fisheries', pp. 213–224) have papers in the symposium in which they stress the complexity of the fishery management problem and the great difficulty of analysing all the relevant factors, even under especially favourable circumstances. Foerster is rather doubtful about the prospects for ever precisely defining the optimum catch, for each year, for most populations. The constantly disturbing influence of natural fluctuation, however, is apparently the main difficulty he foresees; and, as he points out elsewhere, even a system of more or less unchanging annual catch quotas, for different stocks, would probably represent a valuable piece of fisheries management. The effects of fluctuations would be expected to cancel out over a long period. Such quotas might represent (*a*) computed optima, (*b*) empirical optima, or (*c*) mere arbitrary figures. The establishment of any quota of the kind (*b*) or (*c*), at least, should be frankly regarded as an experiment, the results of which might lead to a better estimate of what the quota should be, or in what other way management might be attempted. Foerster also stresses, as does Burkenroad, the great potential importance of more advanced studies in the forecasting of stock fluctuations.

Ricker and Foerster put forward an interesting hypothesis to explain the inverse relationship that often obtains between size of parent stock and size of brood of young surviving: '. . . the more fry present, the less each eats, hence the slower it grows, and hence the longer it remains at a size especially vulnerable to predator attack'. W. C. Herrington ('Limiting factors for fish populations. Some theories and an example', pp. 229–279) thinks that competition for food between parents and young is a better explanation. He believes that such natural fluctuation in brood size, and increased intensity of fishing, have both contributed materially to past declines in abundance of the stock of haddock he has studied. He does not, therefore, adopt the view of Langlois and Burkenroad.

The view that over-fishing does not occur, and that the effect of fishing on a fish stock is always negligible compared with the effects of

the environment, must, in fact, be rejected. It leaves too much to be explained as mere coincidence. A point that was practically overlooked in the Toronto symposium is the fact of certain very high percentage returns, by fishermen, of tags from fish experimentally marked and released. In North Sea plaice, these percentages have been of the order of 50 per cent. in one year (Hickling, 1937). In the California sardine it has been calculated from tagging returns that the fishery takes half the adult stock annually (Clark, 1945). It cannot be argued that fishing mortality is unimportant in at least such cases as these. It is probably true, however, as Huntsman, Langlois and Burkenroad suggest, that decreasing fish-abundance has been sometimes wrongly identified as depletion. There has been a tendency to conclude from rather scanty evidence that depletion has occurred, and to expect it in a particular stock merely because it has occurred in others. One Australian author published a suggestion that certain stocks were depleted because (he stated) another worker had unpublished evidence that most Australian fisheries showed some evidence of depletion. Such statements tend to bring the science into disrepute, and they could result in a nett loss of fish to the community if acted upon by administration. In the present writer's view it would be unfortunate if the views of Burkenroad and Langlois gained general acceptance, but their contributions will be useful if they act as a warning against over-generalization about depletion. Of course these contributions themselves reveal over-generalization of another kind.

As was stated above, most fisheries biologists are already aware of their inability to decide, with absolute certainty, whether any particular decline represents natural change or depletion. Because of this, the 'new movement' of Langlois is not new in anything, except in a difference of emphasis which is certainly excessive. What should be emphasized (not to biologists as much as to fisheries administrators and fishermen) is that the science is still in the trial-and-error stage, that no conclusion is absolutely certain, and that each regulation (or prediction) should itself be regarded as an experiment. This was one point upon which the North American workers were agreed. If this is expressly stated, no biologist need hesitate to indicate overfishing as the most probable cause of the condition he has studied; if that is really the appropriate conclusion to be drawn from adequate evidence, and if other possibilities have been fully considered. One possibility, that appears to warrant more consideration than it has had in the past, is a progressive decline in the suitability of the environment for fish, due to despoliation by man (pollution, siltation, etc.). It is assumed that these effects could be important only in small or circumscribed areas, where they might, by the same token, be controllable. Overfishing could appear as a secondary effect, in a case such as this, because of efforts by the fishermen to maintain their original level of catch from the declining population (Butcher, 1945).

It should ultimately be possible to dispose of the difficulty of identifying the cause of decline or recovery in a population. There is an empirical approach to the problem, which would consist of a long-term study of a stock for detection of possible major cyclic changes in abundance, characteristic of the particular population, which could not reasonably be attributed to fishing. For instance, Burkenroad believes the Pacific halibut stock will begin to decline again within a few years, in spite of the restrictions. It may also be possible to look for signs of such fluctuations in stocks which are now unfished, but which are likely to be fished. There are special difficulties involved in this, but some incidental work on the problem is being done in Australia. The other approach is that which aims at computing the optimum catch as suggested in the fifth paragraph of this paper, from a quantitative study of the expansive properties of the population and the ways in which environmental factors, and man as a predator, may interact with them. If the problem be attacked in this way, the question of the cause of any particular change in abundance becomes secondary, and the work could be done for a stock that was underfished, probably just as well, and as usefully, as if it were overfished. In principle this is the ideal procedure. In practice it may not always be possible, but little serious work of this kind has yet been done.

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UNESCO Programme, 1949*

An abstract of Resolutions, adopted by the General Conference at Beirut, November 1948, pertaining especially to Natural Science.

Reconstruction

The Director-General is instructed to promote and co-ordinate the provision of assistance to war-devastated countries, in the fields of education, science and culture; by collecting, evaluating and distributing information on the changing needs of these countries; by stimulating programmes undertaken by various agencies; by giving detailed information about the needs of selected institutions and indicating highest priorities; and by producing publicity materials for campaigns. He is to collaborate with the Specialized Agencies and other appropriate organs of the United Nations. To meet emergencies, he is to purchase and distribute books, educational material, scientific and technical equipment; and he is to share in providing for the educational, scientific and cultural needs of refugees.

It is recommended to Member States that they should form their own National Committees (of non-governmental organizations) for Educational, Scientific and Cultural Reconstruction, to assist in rebuilding war-devastated countries; and should call upon their educational institutions to provide suitable employment for refugee intellectuals and to furnish them with opportunities to become proficient in the language of the country.

UNESCO will in future years effect a gradual transition from the reconstruction of war-devastated areas to constructive development of education, science and culture.

Education

UNESCO is to carry on clearing-house functions in *Fundamental Education*; and to collect and distribute information on such special aspects as rural small-scale industrial development, health and hygiene, agriculture and the conservation of natural resources. The Director-General is instructed to convene an international conference of leaders and workers in *Adult Education*, including workers in industry and agriculture; and to collect and disseminate information about adult education in Member States. He is to collaborate with the International Labour Office in its study and development of *Vocational Guidance.*

The Director-General is instructed to assist in the establishment of an international non-governmental organization for ensuring continuous *International Co-operation among Universities*; and to promote the exchange of information among national and international organizations of universities.

The Director-General is instructed to assist the International Bureau of Education in its study of the *Rôle of Science in General Education.*

Natural Sciences

World Centre of Scientific Liaison. The Director-General is instructed to carry on the activities of a World Centre of Scientific Liaison. These include such activities as promoting the exchange of scientific information through the Field Science Co-operation Offices; the exchange of scientists and the facilitation of their movements across frontiers; the exchange of information about films on scientific research; abstracting, rationalization and other aspects of scientific documentation; a world register of scientific institutions and scientists; and collaboration with the United Nations and its Specialized Agencies in the field of Applied Science (particularly in any action taken to establish and co-ordinate Cartographic and related reference services, or to set up field teams in Nutritional Science and Food Technology). He is to maintain a Scientific Apparatus Information Service.

Rationalization of Scientific Terminology. The Director-General is instructed to promote the standardization of scientific terminology and the preparation of multilingual dictionaries for special fields of science and technology; and to study the utility of, and if necessary prepare an agenda for, a meeting on the rationalization of scientific publications.

Abstracting. The Director-General is instructed to aid the development of the indexing, abstracting and reviewing of scientific literature, by promoting international collaboration, co-ordination and organization in these fields: and to that end shall convene an International Conference on Scientific Abstracting.

Non-Governmental Organizations. The Director-General is instructed to further international scientific co-operation by means of grants-in-aid and other similar forms of assistance to international scientific and technological organizations, unions and societies; and to provide scientific bodies within Member States with appropriate financial and other aid for carrying out scientific work of international significance along the lines of UNESCO's aims (after consultation with the relevant National Commission, the I.C.S.U., etc.). He is to assist in the international organization of scientists engaged in the fields of engineering, agriculture and medicine.

Conservation of Natural Resources and the Protection of Nature. The Director-General is instructed, in conjunction with the Scientific Conference on the Conservation and Utilization of Natural Resources convened by the Economic and Social Council of the United Nations, to convene an International Conference of the Protection of Nature, under the joint sponsorship of UNESCO and of the I.U. Protection of

* This Journal, *10*, 127, 163 (1948); *11*, 2, 43, 57, 72, 94 (1948); 123, 159 (1949).

Nature; with a view especially to a world-wide programme for the conservation of food resources. Appropriate bodies are to be stimulated to establish regional study groups on questions to be considered.

The Director-General is instructed to inform the Secretary-General of the United Nations that, in the opinion of the General Conference, the raising of nutritional standards (by the conservation of natural resources and other means) is an essential condition for the attainment of UNESCO's purposes in many areas of the world; and he is to offer the services and facilities of UNESCO—in the basic sciences, education and mass communications—in any joint plan for a world-wide attack on the problem.

International Computation Centre. The Director-General is instructed to consider the possibility of an International Computation Centre and plans for its establishment;and to bring the importance of this proposal to the attention of the Committee of Experts on International Laboratories created by the United Nations.

Popularization of Science. The Director-General is instructed to complete the preparation (in co-operation with appropriate international organizations) of summary reports on the popularization of science being carried on by existing national organizations; and to circulate these reports to Member States in order to encourage and guide the establishment of such organizations. He is to draw the attention of governmental and other information services to methods of popularizing science by means of radio, film, pamphlets, competitions, book clubs, science clubs and other means; and to stimulate the preparation and exchange by various agencies of material that will increase the popular understanding of science.

Social Sciences

Tensions Affecting International Understanding. The Director-General is instructed to promote enquiries into population problems affecting international understanding, including the cultural assimilation of immigrants; and into the influence of modern technology upon the attitudes and mutual relationships of peoples.

Social and International Implications of Science. Member States and their National Commissions are requested to initiate group discussions and debates by natural and social scientists upon the social and international implications of science; to co-ordinate the conclusions of their discussions, and to report them in particular to National Commissions.

Philosophy and Humanistic Studies

The Director-General is instructed (in consultation with appropriate scientific associations and international non-governmental organizations) to continue preparations for the publication of books which will provide (for general and specialist readers) an understanding of the *Scientific and Cultural Aspects of the History of Mankind*, of the interdependence of peoples and cultures, and of their contributions to the common heritage. Round-table discussions are to be organized, dealing with philosophic concepts that have special concern for UNESCO's purposes.

Cultural Activities

Reproduction of Unique Objects. It is recommended to Member States that they compile lists of their unique works of art, scientific objects and documents; and that they make as soon as possible at least four reproductions of each, for deposit in centres where their preservation can be assured. UNESCO will assist with advice on reproduction techniques.

Translations of Great Books. The Director-General is instructed to promote adequate translations of classic and contemporary works in literature, philosophy, the humanities, and the social and natural sciences. To that end he shall establish an International Committee for Translations, with which he shall consult (as well as with international non-governmental organizations) on practical problems connected with the selection, translation, publication and distribution of suitable works. He shall encourage Member States to set up *National Translation Committees*; for the purpose of preparing lists of works suitable for translation, of arranging for translation and publication, and of compiling current lists of translations published within their respective countries in the fields concerned.

Bibliographies. The Director-General is instructed to promote bibliographical and documentation services relevant to UNESCO's programme. To that end he shall (with other organizations) conduct a survey of bibliographical services, as a basis for their co-ordination; and shall prepare lists of existing international bibliographies of recognized value; and shall stimulate and assist in the preparation of such bibliographies, for subjects not yet covered. It is recommended to Member States that they promote the compilation and publication of select *National Bibliographies* of current 'best books' relative to UNESCO's aims (in education, science and culture).

Book Exchanges. It is recommended to Member States that they set up *National Book Exchange and Distribution Centres*, as parts of an international system for the exchange and distribution of publications; and that they reduce or eliminate import duties upon books destined for such Centres, and (so far as possible) reduce transport costs on them. The Director-General is to maintain clearing-house activities in the collection, allocation, distribution and exchange of publications; and to promote the organization, maintenance and

development of National Book Centres, and to put them in touch with one another.

He is instructed to promote, through intergovernmental agreements and otherwise, the increase and improvement of exchange of publications (both official and other) between governments, non-governmental institutions and research libraries.

Reproduction of Periodicals. The Director-General is instructed to promote the reproduction (by microfilm, photolithography or other methods) of out-of-print periodicals in selected fields of education, science and culture, so as to supply the needs of libraries in Member States.

Publications Subsidy. The Director-General is instructed to consider the possibility of the establishment of a special fund to assist the publication of works of importance in the field of science and learning, designed for a limited audience.

Copyright. UNESCO shall consider, as a matter of urgency, and with due regard to existing agreements, the problem of improving Copyright on a world basis. The Director-General is instructed to arrange for a comparative and critical study of Copyright problems and of the ways in which they are solved in various countries and between countries, bearing in mind the purpose of furthering universal respect for justice and extending the rule of law and essential freedom. He shall consult with representatives of authors, publishers, workers and the public, as to their rights and needs. He shall circulate the results of the study among Member States; so as to secure comment to submit (with replies to a questionnaire already circulated) to a committee of experts, with a view to the drafting of a *Universal Convention* on Copyright.

Communication

Exchange of Persons. The co-operation of Member States is sought in the preparation of reports showing data on the number, character, availability and sponsorship of governmental and non-governmental fellowships, scholarships and other types of assistance, currently offered for study, research, teaching, and observation. The Director-General is to collect, compile and publish relevant material; and to determine the effectiveness of existing programmes for the exchange of persons, and disseminate the results of this determination. He is to stimulate the establishment of additional governmental and private fellowships and travel grants, suggesting to donors appropriate conditions and standards of award. He is to promote research on the social implications of science, as shown in recent and earlier history, by seeking funds for at least three fellowships.

The Director-General's efforts should be specially concerned with *mature persons*, such as research workers, technicians, teachers, professors, artists, governmental officials, experts, leaders in adult education, and industrial and agricultural workers.

Free Flow of Information. UNESCO will continue and intensify its efforts to remove existing obstacles to the free flow of ideas by word and image. It is recommended to Member States that, where currency exchange control is in force, they maintain at present levels—and if possible increase—the amount of foreign exchange allocated to the purchase from abroad of educational, scientific and cultural books and periodicals. The Director-General is instructed to analyse such obstacles to the free movement between nations, of persons and of educational, scientific and cultural material, as derive from currency and customs regulations, transport costs and lack of transport facilities, and other laws and regulations; and shall prepare proposals for measures to be taken by Member States to eliminate these obstacles; and shall use the facilities of UNESCO to initiate and organize schemes for lessening these difficulties.

To this end he shall complete the study and discussions with governments and appropriate organizations in selected 'soft' currency and 'hard' currency countries, with a view to developing a plan of action for a *Compensation Scheme*, based upon special facilities for residence, or cultural visits, abroad—by students, teachers and technicians—in return for which, credits would be opened for the acquisition of equipment for mass communication, scientific research, art, and other cultural purposes.

He shall operate an *International Book Coupon Scheme* to permit institutions and individuals in 'soft' currency countries to buy books and periodicals from 'hard' currency countries; and shall study its possible extension to other educational, scientific and cultural material, including educational and scientific films.

It is recommended to Member States that they examine existing national regulations and practices governing the importation and purchase of educational, scientific and cultural material, with a view to introducing or extending especially favourable treatment for such material.

World Register. The Director-General is instructed to carry on activities for the collection and dissemination of information about workers, institutions, activities, research resources, and physical facilities—in education, science and culture; and to prepare a plan for a World Register in these fields.

Miscellaneous

In view of the achievements of Ibn Sina, known as *Avicenna*, and of his contribution to the progress of science and philosophy—and in view of the forthcoming celebration of his millenary—it is recommended to Member States that his works in Arabic and Persian be translated and disseminated in other languages.

Scientific Approach to Human Conflict*

To the two questions which it had formulated on the relations between science and peace (This JOURNAL, *11*, 74), the I.C.S.U. Committee on Science and its Social Relations received replies from seventy scientists. An analysis of the replies was prepared, with a brief commentary, and was submitted last November to the Council of the I.C.S.U. and to the Beirut assembly of UNESCO. The seventy scientists are fairly representative of all countries and of all branches of science,† but they include only one woman—Mlle. L. Kaiser (Phonetics, Holland).

The first question concerned the influence of the international character of the spirit of science. The second question asked in what ways scientific organizations and men of science could render their action for peace more effective. One section of the replies to this question dealt with the interchange of persons, with international symposia and with the establishment of international publications; the other section dealt with the direct effects of research. The present article will be confined to extracts from the latter section.

POPULATION AND RESOURCES

Two causes of major warfare are in sight: (a) in the immediate future, a clash between the United States and the Soviet Union, mainly due to lack of understanding between the two sides; (b) as a long range cause, the explosive growth of population everywhere, probably due to increasingly hygienic living.—S. LEFSCHETZ, Mathematics, U.S.A.

To focus attention on the use of science for conserving and developing the world's resources is one of the most effective ways for scientists and scientific organizations to contribute to the maintenance of peace. No single cause of wars can be definitely said to be the most important one, but I am sure that if the world's resources could be developed to take care of economic needs of peoples to a greater extent than in the past, those causes of war which are tied up with economic rivalries would be much less important.—I. AMDUR, Chemistry, U.S.A.

The known factors that lead to war are overpopulation, under-nutrition, uncontrolled greed, and antediluvian religions and philosophies. We know now on the basis of science that the present human race is one species, and there are saner and better ways of controlling excess human reproduction than the methods of war. —A. J. CARLSON, Physiology, U.S.A.

Most modern wars have been brought about as the result of economic pressures, based on the Malthusian principle. Only science can remove the basis of these pressures. Scientific control of population, the production of more efficient crop plants and domestic animals, the proper exploitation of vast areas of potentially usable land, control of soil erosion, development of irrigation and other projects designed to increase arable land, the discovery of new sources of energy—these are activities which will remove the chief cause of war. Without such activities, no amount of talk, or education, will achieve lasting peace.—R. E. CLELAND, Botany, U.S.A.

OPERATIONAL RESEARCH

The first duty of scientists who wish to contribute seriously to the maintenance of peace would be to analyze the existing world situation in all its aspects—economic, social, political, military and psychological. This analysis should be objective and quantitative. In other words, it is concerned with applying to the problem of peace the methods of Operational Research applied with such success by English scientists to military problems. A brilliant model of such treatment is furnished by P. M. Blackett's book, *The Military and Political Aspects of Atomic Energy*. Such an analysis could be made only by a group of men belonging to different disciplines and to different countries—on the one hand, the work which it requires is enormous; on the other hand, in spite of efforts to remain objective, none of us can entirely escape the influence of environment, national and social. It can, therefore, only be a co-operative work. Once this analysis is effected and accepted, one can hope that a way will appear which can be followed so as to avoid armed conflict. The question will then be to present it and have it accepted by the public opinion of the world. —M. MAGAT, Physical Chemistry, France.

SCIENTIFIC METHOD IN SOCIOLOGY

The scientific method can and must be applied to the greatest problems of human life, the problems raised by peoples having to live with one another on a single planet, made small by the advances in the physical sciences. All prior attempts to create conditions conducive to peace have failed. Man must be allowed to use the constructive power of the scientific method in this sphere. This method is not a tool of infinite utility, but until its usefulness in this area has been exhaustively tested, no one has grounds for rejecting it. The survival of the human race as a whole is in jeopardy today.—M. B. VISSCHER, Physiology, U.S.A.

The social sciences are feeble and groping, and mental ones hardly less so, and many maintain that human problems must remain extra-scientific. Most scientists are convinced otherwise, and this position at least has the merit

* This JOURNAL, *11*, 124, 137 (1949).

† Astronomy, 10; Astrophysics, 2; Physics, 10; Mathematics, 5; Mathematical Physics, 1; Mechanics, 2; Physical Chemistry, 1; Pharmacology, 2; Chemistry, 6; Biochemistry, 2; Biology, 3; Microbiology, 2; Botany, 3; Zoology, 2; Physiology, 5; Palaeontology, Archaeology, Anthropology, Phonetics, Psychology, Philosophy, Philosophy-and-Education, Economics, International Law, one each, not stated, 5.

United States, 34; United Kingdom, 9; Holland, 9; Belgium, 5; India, Norway, South Africa, Switzerland, France, Denmark, Chile, 2 each; Germany, Poland, China, Argentina, Norway, Czechoslovakia, Brazil, Bulgaria, Mexico, one each.

Australia, New Zealand, Canada, Sweden and Italy were not represented.

of inviting rather than dissuading effort. Other modes of thought and feeling have been tried and have failed to achieve harmony among men. The mode of science—rational extrapolation from reliable knowledge, subjected to operational test—may also fail, but it surely deserves its trial. This is, indeed, also the avowed mode of democratic government and is being approached, however slowly, in actuality. —R. W. GERARD, Physiology, U.S.A.

Perhaps the social scientists could contribute more than any other group to the cause of peace by studying the fundamental problems which lead to war and especially by studying the psychology of man and of societies.—P. J. DU TOIT, South Africa.

If it is evidently better to orient scientific discoveries towards the amelioration of conditions of life (material and moral) of a pacific mankind, rather than towards the development of methods of destruction, it is necessary to consider the scientific method.

One may state that the researchers who correctly use the scientific method in their own domain abandon it too easily when there is a question of applying it to the social, moral or political domain. In order that the scientific method may be applicable to a problem, it is in fact necessary that the data can be reduced to measurable quantities. On the other hand, the order of complexity of problems which can be attacked scientifically is still very limited, while certain problems raised by human life and the nature of man are of a very great variety and of a range sometimes disconcerting. It may be hoped that the accumulation of facts controlled through scientific criteria, and new developments of scientific method and equipment, will allow this group of problems to be reduced little by little. In this connexion, the first effort should be directed to making the scientists themselves accept the fact that the scientific method is one and indivisible.—P. SWINGS, Astrophysics, Belgium.

A CODE FOR SCIENTISTS

One could also perhaps envisage the establishment of a code of honour for scientists, forbidding them, under pain of exclusion from all learned societies, from working on certain subjects whose unique application would be the creation of weapons of mass destruction (such as bacteriological weapons).—M. MAGAT, Physical Chemistry, France.

The study of chemical, bacteriological and physical methods as weapons of destruction should be excluded from the activity of scientific workers.—C. HEYMANS, Pharmacology, Belgium.

It might be thought that one way in which scientists could be effective would be by arranging to strike, and not to handle poison gas warfare, and so on. Any such attempts would be quite illusory in my opinion, because poison gas activities are so closely related to ordinary scientific activities carried out for the welfare of mankind, such as the destruction of noxious insects, the destruction of disease parasites, and in fact, pharmacology generally. It would, therefore, be impossible to eliminate those aspects of toxicology and pharmacology which only applied to warfare.—R. A. PETERS, Biochemistry, Great Britain.

POPULARIZATION

More factual scientific education and understanding of the population in all lands would greatly diminish the drives or needs for war. This phase of education on an international scale is primarily a social responsibility of the scientists.—A. J. CARLSON, Physiology, U.S.A.

Men of science could act in the direction of obtaining in all countries an orientation of teaching, especially in the lower grades, granting a larger part to the study of the disciplines and methods of scientific work. This would contribute to the formation of masses capable of judging events in a more reasonable and objective manner, and perhaps correspondingly reduce the part hitherto reserved for unbridled passions fed by false, easily exploited ideas.—M. OZORIO DE ALMEIDA, Physiology, Brazil.

The simplest means to intensify the action of scientists would be to contribute towards making the scientific spirit penetrate into the masses.—P. SWINGS, Astrophysics, Belgium.

Sound methods of popularizing science are the best contribution scientists and scientific organizations can make to the maintenance of international peace and understanding. It must at all costs be avoided that scientists become a 'priestly caste' outside the community.—W. H. VAN DEN BOS, Astronomy, South Africa.

FUNDAMENTAL PRINCIPLES

In attacking a large scientific problem we all go back to fundamental principles, and we face our problems fairly and squarely. If they involve very difficult things, we nevertheless recognize that our problems are difficult and do not try to solve major problems by following up side issues or the minor fringes. The problem of securing peace is the greatest that humanity has ever faced, and scientists will do their best in furthering this problem if they frankly recognize the fundamental problem, namely, World Government, and speak those words firmly and fearlessly whenever the question is introduced. Without this there is no hope any way.—H. C. UREY, Chemistry, U.S.A.

The Royal Australian Chemical Institute

THE Institute, for the foundation of which in 1917 Sir David Orme Masson (then Professor of Chemistry at the University of Melbourne) was largely responsible, is a scientific and professional body comprising the majority of qualified chemists in Australia. In 1923 it was incorporated under the New South Wales Companies Act, and in 1932 by Royal Charter; it is thus the oldest chartered scientific-and-professional body in Australia.

The principal objects of the Institute are to promote the science and practice of chemistry in all its branches, to ensure a high standard of ethics and of academic and practical competency in persons admitted as members, and to increase the confidence of the

community in chemists and in the service they can render to the community.

There are two classes of members—Fellows (F.A.C.I.) and Associates (A.A.C.I.). The minimum qualification for admission as an Associate is the degree of Bachelor of Science, in chemistry (or its equivalent), plus at least two years' approved practice in a laboratory or chemical works. The Institute also interests itself in the welfare of students preparing for the profession of chemistry. It advises teaching institutions on suitable courses of study and it maintains a register of approved students, who are encouraged to attend Institute meetings and to take an early interest in their profession.

The general government is vested in the Council, which consists of the President of the Institute, the Presidents of Branch committees, the Honorary General Secretary and the Honorary General Treasurer. Headquarters of the Institute were originally in Sydney, but were transferred to Melbourne in 1933. Here the Council meets monthly, the five members from other States attending by proxy, except for at least one meeting every two years, when they all attend in person.

A Branch of the Institute is established in each State, and Branch affairs are controlled by committees. Within some Branches there are sections at provincial centres. In most Branches groups have been formed for more convenient meeting and discussion of special fields of chemistry. In addition, courses of post-graduate lectures in a chosen field are provided annually. From time to time a Branch may also organize a chemical exhibition to inform the public of the wide activities of the chemist in industries and the place of the chemist in their everyday lives. The latest of such exhibitions was held in Adelaide in April 1949.

Two prizes are awarded annually — the Smith Memorial Medal and the Rennie Memorial Medal. The Smith Medal was originally awarded for work having reference to Australian natural products; but for the past few years it has been awarded to the member who has contributed most towards the development of some branch of chemical science, the contribution being judged from research work published or accepted for publication during the previous ten years. The Rennie Medal is awarded under similar conditions, but is restricted to members not over 30 years of age. An annual Scholarship—the Masson Memorial—is awarded on academic record to a member or registered student who has attained the academic qualification necessary for Associateship, to assist him in a further year's work at a university or technical college. In some Branches there are additional prizes for students.

The publications of the Institute are 'Chemistry as a Profession in Australia', a pamphlet for which there has been a lively demand, and *Journal and Proceedings*, published monthly. 'Standard Methods for the Analysis of Foodstuffs', three editions of which were published by Australian Commonwealth Food Control, was compiled by a committee of the Institute, which is now engaged in preparing a further revised edition.

On the professional side, the Institute has made a substantial contribution towards improving the status of chemists. Not only do employers look to it for determining qualifications, but also for guidance in fixing salaries and conditions of employment. Membership is recognized as a qualification by Commonwealth and State governments. The Institute's membership now includes 1926 Fellows and Associates, and 791 Students; ten years ago the figures were 891 and 459 respectively.

Apart from the work of its members on the Council and on committees (and many leading members of the profession have served or are serving on these), the Institute has had two notable benefactors—Russell Grimwade, part of whose gift will establish the Russell Grimwade Lecture, and William Henry Corbould, news of whose legacy has recently been received. These benefactions are not only substantial, but are reminders that the Institute has attained a position in the community which merits them.

News

A.N.Z.A.A.S. Brisbane Meeting, 1951

At the Hobart meeting of the Australian and New Zealand Association for the Advancement of Science it was agreed that the next meeting should be held in Brisbane in May 1950, provided that suitable arrangements could be made.

In view of difficulties in obtaining lecture rooms and other accommodation, caused by a meeting of the British Medical Association being held in Brisbane in May 1950, it has been decided to postpone the A.N.Z.A.A.S. meeting until 1951. The next meeting of the Australian and New Zealand Association for the Advancement of Science will therefore be held in Brisbane from 23 May to 30 May 1951.

Proceedings of the Seventh Pacific Science Congress

The Organizing Committee of the Seventh Pacific Science Congress proposes to publish the Proceedings in single divisional (or in appropriately grouped divisional) volumes, and to offer single volumes as well as sets for sale. No decision can yet be made as to the grouping of these volumes, or of price, but something of the following order and prices may eventuate:

Vol. I: General Proceedings, Narrative, Representation, Attendance, Research Plan Report, 150 pp. 7*s*. 6*d*.

Vol. II: Geology, Geophysics and Vulcanology, 600 pp., £1 8*s*. 6*d*.

Vol. III: Meteorology and Oceanography, 400 pp., £1.
Vol. IV: Zoology, 550 pp., £1 6*s*.
Vol. V: Botany; Soil Resources, Agriculture and Forestry, 550 pp., £1 6*s*.
or V: Botany, 250 pp., 11*s*. 6*d*.
VI: Soil Resources, etc., 300 pp., 14*s*. 6*d*.
Vol. VI (*or* VII): Anthropology; Public Health and Nutrition; Social Sciences, 550 pp., £1 6*s*.

The prices are in New Zealand currency. It will be realized that the larger the initial order for printing, the lower the cost of individual volumes. Early registration with THE SECRETARY-GENERAL, Box 27, Newmarket, Auckland, S.E.1, N.Z., will therefore ensure a copy being available and contribute to lowering the cost. It is hoped to complete the printing by March, 1950.

The plans for the Proceedings include the publication of accepted papers substantially as submitted, though the Editorial Committee may have to consider whether extensive tables and numerous illustrations can be published. The criterion for acceptance of papers, recommended by the Pacific Science Council to the Organizers of the Seventh Congress, is their relévance to the scientific problems of the Pacific. Authors will receive complimentary separates (either twenty-five or fifty, the number not decided yet) and may order any additional number at cost. Separate order forms will be sent to authors in due course.

Where a paper received at the Congress is to be published elsewhere than in the Proceedings, authors are requested to supply the reference to the periodical (including volume number and date).

For papers published elsewhere, an abstract of the paper will be included in the *Proceedings*, together with the reference to where the full paper may be read; and authors are requested to take the opportunity, if they wish, of revising any abstract previously submitted, or extending it up to a maximum of 350 words.

Handbook of Societies and Institutions

The Information Service of the C.S.I.R.O. is proposing to compile a *Handbook* of Australian research institutions, and scientific and technical societies, somewhat on the lines of the wartime publication *Science and Service*. The Handbook will be made available to the scientific public and will include brief details of the history, location, organization of activities, membership, publications, etc., of each institution listed. The information will be collected largely by means of questionnaires.

Secretaries of societies or institutions which would like to be included in the list and have not yet received a copy of the questionnaire, should write to the Officer in Charge, C.S.I.R.O. Information Service, 314 Albert Street, East Melbourne, C.2, Victoria. A further announcement will be made in This JOURNAL when the *Handbook* is published.

Nuffield Foundation
Dominion Travelling Fellowships

The Trustees of the Nuffield Foundation have announced that they will offer to Australian graduates various travelling fellowships to begin in 1950. Three of these will be in Medicine, the others being in the Natural Sciences (2), the Humanities (1) and the Social Sciences (1). The purpose of the fellowships is to enable men or women who are Australian graduates of outstanding ability to gain experience and training in the United Kingdom in their chosen fields, and to make contact there with scholars working in those fields, with a view to the Fellows' equipping themselves to take up senior posts in research and teaching in Australia. A Fellow will be expected to resume residence in Australia on the completion of the fellowship.

The awards are available to Australian nationals, normally between the ages of 25 and 35 years, preferably holding a Master's or Doctor's degree with a year or more of subsequent teaching or research experience on the staff of a university or comparable institution. The fellowships will normally be tenable for one year and will be of the value of between £600 and £800 (sterling) per annum (exclusive of travelling expenses), according to individual circumstances.

Applications for 1950 fellowships should be submitted not later than November 1, 1949, to the Secretary, Nuffield Foundation Australian Advisory Committee, c.o. University of Melbourne, Carlton, N.3, Victoria, from whom copies of the application form may be obtained.

Giblin Studentship

The Congregation of King's College, Cambridge, has established the Giblin Studentship for award to an Australian graduate. The Student will be required to reside at the College for two years, with a stipend of £200 per annum, to take an approved course of study or research. The award in 1950 will be allotted to the University of Melbourne, which will select a junior member of its staff.

David Syme Research Prize

The David Syme Research Prize for 1949 has been awarded to F. J. Fenner, the Professor-Elect of Micro-biology in the Australian National University. Professor Fenner was formerly Haley Research Fellow of the Walter and Eliza Hall Institute and is at present in America at the Rockefeller Institute of Medical Research.

The prize has been awarded in recognition of work upon the ectromelia virus, which produces mousepox in mice—covering the mode of spread of the disease, its epidemiology, the transmission of maternal immunity to the young, and the pathogenesis of the skin rash which accompanies the infection. Apparently the mouse disease is a laboratory model of human smallpox, the viruses responsible being

identical, apart from the hosts in which they are lodged. This relationship was previously unsuspected and the work breaks into an entirely new field.

Harbison-Higinbotham Research Scholarship

The 1949 award of the Harbison-Higinbotham Scholarship has been made to Donald F. Thomson, O.B.E., D.Sc., F.R.G.S., Research Fellow in Anthropology in the University of Melbourne, for a paper on 'The Economic Structure and the Ceremonial Exchange Cycle in Arnhem Land', which deals with the specialized manufacture by natives of flint spear-heads, ceremonial equipment, and other artifacts, and their ceremonial distribution through the tribes. The Scholarship is given for research in history, sociology and similar fields. It was also awarded to Dr. Thomson on a previous occasion, in 1943.

Dr. Thomson has led a number of expeditions to the Cape York Peninsula and Arnhem Land. In 1936 he was awarded the Syme Prize, and in 1938 a Rockefeller Travelling Fellowship at Christ's College, Cambridge. During the war he was a wing-commander with the R.A.A.F. in northern Australian waters and in Dutch New Guinea.

Exhibition of 1851 Science Research Scholarships

Two '1851' Scholarships for the year 1949 have been awarded to graduates of the University of Melbourne—to David Caro (Physics) and Raymond Martin (Chemistry). These scholarships are awarded to men and women under 26 years of age who have shown outstanding capacity for scientific investigation. A total of ten overseas '1851' Scholarships are awarded each year in the British Commonwealth.

David Caro proposes to work in Birmingham in Professor Oliphant's laboratory. During the past two years he has been engaged upon the construction of a cosmic ray spectrometer. He assisted in the design and construction of the cosmic ray apparatus for the Antarctic expedition. During the war he served with the R.A.A.F. as an instructor in radar.

Raymond Martin will work on physical inorganic chemistry under Professor Emeleus in Cambridge. For the past three years he has been investigating the properties of praesodymium, obtained from monazite sands from Byron Bay. A unique feature of his award is that his father won the same scholarship in 1923, proceeding to the Cavendish Laboratory, Cambridge, under Rutherford, and now being Professor L. H. Martin, of the Chair of Physics in the University of Melbourne.

Premio Europeo Cortina: Professor John Read

John Read, Professor of Chemistry and Director of the Chemistry Research Laboratory in St. Andrews University, and formerly Professor of Organic Chemistry in the University of Sydney, Australia, has been awarded the Premio Europeo Cortina prize of 1,000,000 lire (£500) for his book, *A Direct Entry to Organic Chemistry* (published by Methuen, London). It was judged to be the best popular scientific work published in any language in the last five years. The prize, offered by the city of Cortina in conjunction with the Italian review *Ulisse*, brought forward ninety-five works, from every country in Europe. The prize has been founded 'in the belief that culture should be an instrument of civilization and life, and not the exclusive inheritance of the privileged'.

The British entries were considered outstanding by a panel of Italian scientists and educationists, nominated by universities and learned societies. The final choice lay between Professor Read and Professor O. R. Frisch, of Trinity College, Cambridge. A majority verdict gave the award to Professor Read, and Professor Frisch's book, *Meet the Atoms*, was highly commended.

Armourers and Brasiers' Research Fellowship

A Joint Committee of the Royal Society of London and the Armourers and Brasiers' Company have appointed Robert William Kerr Honeycombe, of the Cavendish Laboratory, Cambridge, to the Armourers and Brasiers' Research Fellowship for two years from 1 October, 1949. The appointment is renewable year by year for a further three years.

Mr. Honeycombe was formerly of the University of Melbourne, where he graduated B.Sc. in 1941 and M.Sc. in 1943. He will work on the inhomogeneity of plastic deformation in metals, and the influence of inhomogeneities upon recrystallization and recovery.

'Experimental Cell Research'

A new journal is being launched under the auspices of the International Society for Cell Biology. *Experimental Cell Research* will publish papers dealing with experimental analysis of the activity, structure and organization of the cell and its sub-units, including work on virus. Technical or theoretical papers aiming at the further development of methods in the field of experimental cytology will also be included. The journal will be under the imprint of Academic Press Inc., New York. One volume, consisting of four issues, will be published annually.

Experimental Cell Research will be edited by Törbjorn Caspersson, Stockholm; Honor Fell, Cambridge, England; John Runnström, Stockholm; Francis O. Schmitt, Cambridge, Mass., U.S.A.; Paul Weiss, Chicago, Ill., U.S.A.; Ralph W. C. Wyckoff, Bethesda, Maryland, U.S.A. In addition, J. F. Danielli, London, will act as editor of communications from the Society for Cell Biology. Papers may be submitted in English, French or German. Authors residing in the Western Hemisphere should send their papers to American editors; those

residing in the British Commonwealth (other than Canada) should mail them to Dr. Honor Fell, Cambridge; those in other countries should send to the Scandinavian editors.

Survey of the Ord-Victoria Region

A survey party from the C.S.I.R.O. left in May to examine the regions of the Ord and Victoria Rivers in northern Australia. The scientific members are C. S. Christian, leader and agrostologist; G. A. Stewart, soil surveyor; R. A. Perry, botanist; D. Traves (Bureau of Mineral Resources), geologist. Investigations will include an examination of over 200,000 acres on the Ord River flats, which are being examined as a possible irrigation area for crops such as rice, cotton, tobacco, peanuts and sorghum.

The present survey is one of a series recommended in 1946 by the North Australia Development Committee, which includes representation from the Commonwealth, Western Australia and Queensland. Previous reconnaissance surveys under this scheme have been conducted in the Katherine-Darwin region in 1946 and in the Barkly Tableland region in 1947. The general objectives of these surveys are, firstly, to record and map the nature of the country; secondly, to assess potentialities for development, and possible land use.

The present expedition is especially noteworthy as being one of the few occasions, perhaps the first occasion, when an Australian Government has requested a team of scientists to combine, as a team, to investigate the potentialities of a large, relatively-undeveloped region.

School in Marine Biology

The sixth School in Marine Biology, at the C.S.I.R.O. Division of Fisheries, Cronulla, was held this year for the week commencing 6 August. In all, thirteen attended, including students and staff from the Departments of Biochemistry and Zoology of the University of Sydney.

A symposium on the 'Structure and Function of Muscle' was held, and practical work carried out in the laboratory was as follows:

Muscle-Nerve Preparations. Experiments were set up with preparations of crab muscle, to demonstrate innervation and effect of eserine, acetyl choline and inorganic salts.

Biochemistry of Tunicates. Using *Pyura*, the distribution of reducing substances and haem compounds was determined, using spectroscopic and chemical methods. In addition, the formation of ammonia and the breakdown of glycerophosphate and sodium pyrophosphate by this organism was compared with similar process in other marine animals.

Respiratory Pigments. The absorption spectra of bloods from a number of marine animals were compared.

University of Tasmania

G. T. J. Wilson, senior lecturer in history, has been granted leave of absence for twelve months from October next, to take up a fellowship granted by the Australian National University to visit India. B. I. H. Scott, lecturer in physics, is visiting the University of British Columbia at the invitation of Professor G. M. Shrum, where he will demonstrate the methods of teaching experimental physics developed in Tasmania and will at the same time pursue his research in biophysics. Miss Beryl Scott, of the Department of Geology, has been awarded the Teenie Robertson Mitchell Memorial Fellowship given by Rotary International. Miss Scott will sail for England in August and will spend a year in Cambridge studying the late Pre-Cambrian pillow lavas of King Island.

Professor T. Hytten has been appointed Vice-Chancellor of the University of Tasmania, which office has recently been extended to a full-time one. Professor Hytten will take up his duties in August. Professor Alan Burn, who has since 1945 combined the office of Vice-Chancellor with that of Professor of Engineering, will now be able to concentrate his attention upon the interests of his Chair.

Professor L. G. G. Huxley, of the University of Adelaide, has been invited to visit Tasmania later this year to deliver a special series of lectures on Wave Guides and Transmission. J. B. Polya has commenced work on the formulation of diagnostic tests for cancer, following a donation by Mr. E. J. Hallstrom of £4200 for two years for the biochemical investigation of problems relating to cancer.

H. A. Buchdahl, lecturer in mathematical physics, has been admitted to the degree of Doctor of Science for his thesis in the fields of Optics (Algebraic methods for the determination of the geometrical higher order aberrations of optical systems) and Relativity Mathematics (On Tensors arising from co-ordinate-invariant and gauge-invariant action integrals). Dr. Joan Ford, who was recently admitted to the degree of Doctor of Philosophy, is the first person to receive this degree in this University. Her thesis was on mutations produced by monochromatic ultra-violet irradiation and X-radiation of fungal spores of Chaetomium.

University of Western Australia

Recommendations for the establishment of a Medical School are being considered by the State Government. It is proposed that a man of administrative capacity and scientific prestige should make a survey of medical schools elsewhere and should then be given executive power to put into effect all decisions necessary for formation of the proposed school; that the three main Perth hospitals should co-operate in the establishment of the school; and that buildings to house the preclinical departments should be commenced by October, 1950, with teaching to commence in 1952 or 1953. It is

expected that buildings and equipment will cost £180,000.

University of Otago

The first Professor of Mining, in the newly-created Chair, is J. Ivon Graham, a distinguished research worker and adviser on coal mining from Britain. The first occupant of the new Chair of Biochemistry in the Medical School is N. L. Edson, who has been associate professor in that subject.

University of Melbourne

Professor J. T. Burke, who is approaching the end of his three-year apointment to the 'Herald' Chair of Fine Arts, has been appointed to a permanent Chair. Sir Alan Newton, who a few years ago inspired the creation of a Department of Clinical Studies and launched it as Honorary Director, has been compelled to resign through ill health. Leave of absence has been granted to Professor Turner to act on the Board of Higher Forestry Education; J. H. Chinner will act as his deputy for University duties. The status of Associate Professor has been granted to W. A. Rawlinson, senior lecturer in Biochemistry. Assoc. Prof. Rawlinson, who was at the Hall Institute (Melbourne) before coming to the University staff, was overseas as Wellcome Foundation Fellow in 1947–48, chiefly in the Chemical Pathology Laboratories of the University College Hospital Medical School, London. His research has been generally upon the application of physical methods to biochemical problems, with particular reference to the biological catalysts concerned with respiration. In 1942 he was awarded the Rennie Memorial Medal of the Australian Chemical Institute.

The Department of Surveying, under the direction of Associate Professor Thornton Smith, has received the appointment of a senior lecturer in Surveying, J. V. Buley. Mr. Buley, who is a Melbourne graduate, has had experience as government mining surveyor on Victorian goldfields; upon oil exploration work in Papua and Queensland; in army survey service during the war; as senior field geologist in the Victorian Mines Department; and as mine manager of Golden Plateau, N.L., in Queensland. Associate Professor Thornton Smith has been granted leave of absence from January to May, 1950, to study photogrammetry at Zürich.

Other recent appointments include L. E. Baragwanah, lecturer in History; P. D. Langley, lecturer in Psychology; R. J. Storer, senior lecturer in Mathematics; R. Cartwright, senior lecturer in Education; C. J. R. Gorrie, to status of senior lecturer as Veterinary Research Officer.

Leave of absence for one year has been granted to F. Laszlo, senior lecturer in Civil Engineering.

The death is announced of Dr. Alice Mary Barber, part-time lecturer in Mental Hygiene and part-time psychiatrist in the Department of Social Studies.

The degree of Doctor of Science has been conferred upon Alfred Gottschalk, Doctor of Medicine of the University of Bonn, who is at present on biochemical research at the Hall Institute. His researches have been upon carbohydrate biochemistry and enzyme specificity, contributing to knowledge of microbiology from the point of view of carbohydrate metabolism and fermentation mechanism.

The Grimwade Prize for 1949 has been awarded to R. C. Croft, of the C.S.I.R.O. Division of Industrial Chemistry, for a thesis on the Beneficiation and Processing of South Australian Graphite and Study of its Lamellar Compounds. Travelling research scholarships have been awarded to O. W. Parnaby (History), M. C. Kemp (Economics), and A. C. Hurley (Mathematics). Re-awards of travelling scholarships for a second year abroad have been made to C. A. Hurst (Mathematics), D. L. Gunner (Philosophy) and O. P. Singleton (Geology).

The Faculty of Medicine has adopted a resolution reached by the Medical Research Committee, recommending that the State Government be approached for a grant of £5000 for medical research purposes, inasmuch as the block grants provided by the National Health and Medical Research Council have proved inadequate. The Faculty of Engineering has prepared a rearrangement and consolidation of the courses of the first three undergraduate years, which result in a slight decrease in total work. Degrees of Master of Architecture and Doctor of Architecture have been established, the former requiring a satisfactory professional status of five years together with a thesis or report, and the latter requiring evidence of advanced research which has contributed substantially to architectural knowledge.

The University has established a committee to consider the appraisal of overseas qualifications for students wishing to enter the University, and to consider the question of personal guidance and oversight for incoming foreign students.

Dr. A. L. Hagedoorn, when visiting Melbourne, delivered a lecture upon 'Modern Developments in Animal Breeding'. Professor F. S. C. Northrop, of Yale University, gave a series of five lectures on 'Foundations of World Order'. Inaugural lectures were given by Professor C. E. Moorhouse, on 'The Interest of Engineering', and by Professor B. H. Higgins, on 'What do Economists Know?'. The Beattie-Smith Memorial Lecturer for 1949 is H. F. Maudsley, whose subject is 'Whither Psychiatry?'.

Recent benefactions have included £100 from Broken Hill Pty. Co. Ltd. towards expenses incurred by Professor Worner's staff in visiting metallurgical centres throughout the Commonwealth, together with £100 towards research work in the Appointments Board; £200 from

Burroughs Wellcome and Co. (Aust.) Ltd. for work on biological assay in the Physiology Department; £100 from G. A. Whiting, for expenses of practical work in the final year of the Town Planning course; £25 from the Pharmaceutical Society of Victoria, for the Bacteriology Department; £147 from the Mathematical Association of Victoria, for the Michell-Barnard Memorial; £250 from Nicholas Pty. Ltd., for biological tests in the Physiology Department; £5,000 from Victor Kimpton, for the School of Agriculture; £50 from Nicholas Pty. Ltd., towards travelling expenses of the Director of Visual Aids; £100 from Broken Hill Associated Smelters Pty. Ltd., for the Appointments Board Research Fund; £50 from Vacuum Oil Co. Pty. Ltd. and £50 from Shell Oil Co. of Australia Ltd., for the same fund, and sums amounting to £172 5*s.* from seven other donors for the same fund; 100 copies of the booklet, *The Nature of Tropical Diseases*, from Bayer Pharma Ltd.; £6,000 from an anonymous donor as the second part of a gift to the Conservatorium; and sums amounting to £879 10*s.* from ten other donors, mostly for particular purposes.

The Scientific Societies

Royal Society of Tasmania.
June: N. R. Laird—The Australian Antarctic Expedition.
July: E. R. Guiler—Marine littoral ecology.
August: G. C. Wade—Some diseases of ornamental plants.

Royal Society of New South Wales.
August: G. E. Mapstone—Nitrogen in oil shale and shale oil. XI. Nitriles in cracked shale gasoline.
G. E. Calf and E. Ritchie—The cyclization of anils of -keto-aldehydes.
K. H. B. Green and E. Ritchie—Some reactions of an angular phenyl compound.
A. Bolliger (lecture)—The response of marsupials to pathogenes.
R. O. Chalmers—Wolf's Creek meteorite crater.

Royal Society of South Australia.
August: B. C. Cotton—An old mangrove mud flat exposed by wave scouring at Glenelg, S.A.
T. H. Johnston and P. M. Mawson—Some Nematodes from Australian hosts.

Royal Society of Victoria.
June: A. R. Alderman (lecture)—Some observations on recent developments in the mineral sciences.
July: J. T. Jutson—On the terminology and classification of shore platforms.
L. C. King—The cyclic landsurfaces of Australia.
A. B. Edwards—Petrology of the Cainozoic rocks of Tasmania.
E. D. Gill—The geology of Picnic Point, Port Phillip Bay, Victoria.
E. D. Gill—Sandringham Sands: a formational name for certain sediments in the vicinity of Melbourne, Victoria.
August: Fritz Lowe (lecture)—The meteorological basis of artificial rain.

Royal Society of Queensland.
June: Film on atomic physics.
July: Exhibits.
August: W. V. Macfarlane (lecture)—Human reactions to atomic radiations—a survey of five hundred years.

Royal Society of Western Australia.
June: P. Kott—Eunicidae and Nereidae of South-western Australia, with some notes on the ecology of Western Australia and limestone reefs, and particular reference to Polychaet worm fauna.
E. de C. Clarke, J. K. Prendergast, C. Teichert and R. W. Fairbridge—Permian successions in part of the Irwin River basin, W.A.
F. R. Feldtman—Pectens of the Gingin chalk.
August: G. F. Elliott—The internal structure of some Cretaceous Brachiopoda from Gingin.

Medical Sciences Club of South Australia.
June: T. L. McLarty—Preliminary observations on hyaluronidase activity in glaucoma.
W. A. Dibden—Studies on physiological responses in nervous people.
July: P. M. Nossal—Respiratory mechanisms of erythrocytes.
L. A. T. Ballard—Some recent views on plant growth substances and their activity.
A. J. K. Walker—Some recent advances in the control of weeds by chemical methods.
August: J. G. Wood—Distribution of zinc in plants and one aspect of its metabolism.
I. G. Jarrett—The function of the adrenal cortex.

Victorian Society of Pathology and Experimental Medicine.
July: R. H. Watson—Termination of pregnancy in sheep following the administration of hexoestrol during its early stages.
Betty Wicks and Nancy Hayward—The microbiological assay of folic acid and its application to clinical studies of pernicious anæmia.
T Lowe—Mechanical factors influencing coronary artery blood flow.

Queensland Institute of Medical Research

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Applications close with Secretary of Institute, Department of Health and Home Affairs, Brisbane, on 9 January 1950. Copies of not more than three testimonials may be attached to application, and names of two referees, to whom direct enquiries may be made, must be included. Further information is obtainable from the Secretary.

Letters to the Editor

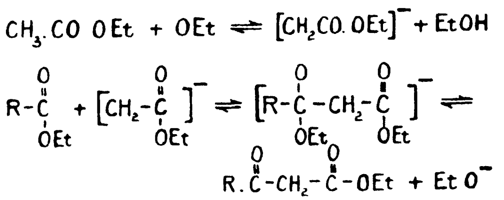
The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

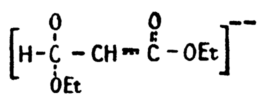
Original Work

The Structure of the Sodium Salt of Ethyl Formyl Acetate

Silberman and Silberman-Martyncewa (1949) made the interesting observation that whenever the preparation of the sodium salt of ethyl formyl acetate was attempted, a compound of the composition $NaOCH{=}CHCOOC_2H_5 \cdot C_2H_5ONa$ was obtained. It seems to me that the formation and the structure of such a compound can be explained on the basis of the accepted mechanism of Claisen condensations. According to Hammett (1940) a typical Claisen condensation proceeds by the following steps:



In a condensation with formic ester (where R = H) the last step, the loss of an ethoxide ion, apparently does not occur. This is explained by the fact that R = H has a much smaller electron-releasing effect than R = alkyl. Instead of the loss of EtO^-, a proton is lost by enolization giving:



The 'sodium salt of ethyl formyl acetate' is the combination of this anion with two sodium ions.

S. J. Angyal.

Chemistry Department,
University of Sydney,
30 May 1949.

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Hammett, L. P. (1940): *Physical Organic Chemistry*, 360. New York: McGraw-Hill.

The Occurrence of Fructose in the Grasshopper, Locusta Migratoria

The presence of fructose in the seminal fluid and accessory male reproductive tissues of a number of vertebrates, and the function of this compound in the economy of these organisms, have been established by Mann (1948). Depending on the particular species in question, the fructose is formed in the seminal vesicle, the prostate, the coagulating gland, or the ampulla of the *vas deferens*. In the same or similar tissue there is also present citric acid (Scherstén, 1936; Humphrey and Mann, 1948), and both fructose and citric acid pass into the semen on ejaculation.

Among the lower animals an elasmobranch (the dogfish, *Scylliorhinus caniculus*) has been examined and the semen found to contain fructose but not citric acid (Humphrey and Mann, 1948). Recently (Levenbook, 1947), it has been reported that the yeast-fermentable reducing substance present in the haemolymph of the larva of *Gastrophilus intestinalis* can be accounted for as fructose. In other insects, however, no appreciable amount of fructose could be detected in adult or larval forms.

In the grasshopper, *Locusta migratoria*, the male accessory reproductive organs include testis, *vas deferens*, *vesicula seminalis* and accessory gland. In this investigation the organs were separated into testis and 'accessory male tissue' (*vas deferens*, *vesicula seminalis* and accessory gland).

Results

Table 1 shows, for various organs of the grasshopper, the amount of fructose present, as estimated by the method of Roe (1934), after deproteinization with trichloracetic acid. No citric acid could be detected by the pentabromacetone method (Krebs and Eggleston, 1944).

Table 1
Presence of fructose in grasshopper tissue.
mg. fructose/100 gm.

Testis	103
Accessory male tissue	85
Female reproductive organs	0
Blood	35

Thus the fructose is present only in the male animals. Also, the fructose occurs mainly as the free sugar (Table 2). Here the testis and accessory tissue from several male grasshoppers were used. The material was extracted with boiling alcohol, the alcohol removed *in vacuo*, and the residue taken up in water.

Table 2
Fermentable sugar in grasshopper tissue.
363 mg. tissue used; figures are mg. 'fructose' in 100 gm. fresh tissue.

Residue after alcohol extraction ..	15
Alcohol extract before fermentation ..	47
Alcohol extract after fermentation ..	4

Therefore, most of the total fructose is present in the free, fermentable form.

These results confirm the widespread occurrence of fructose in the male reproductive organs of many species, and show that citric acid is not so widely distributed.

Although the concentration of fructose in the grasshopper testis is quite high in relation to other animals, it is difficult to make direct comparisons between species owing to large differences in the structure of the tissues of the various animals so far investigated.

G. F. HUMPHREY.
MARJORY ROBERTSON.

Department of Biochemistry,
University of Sydney,
17 June 1949.

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The C-Mitotic Activity of Cryptopleurine

As part of the C.S.I.R. drug plant survey, a number of plant extracts and pharmacologically active substances obtained from native plants are being examined for c-mitotic activity.

The milled plant material is extracted by cold percolation with 95 per cent. ethyl alcohol. The alcohol is removed and the residue taken up in water, heated if necessary, to coagulate the precipitates, and filtered when cool. Extracts so obtained are tested on the root tips of germinating onion seed at different concentrations and for varying periods of time. The root tips are examined by the lacmoid squash method. So far some twenty-one extracts have given positive reactions. In the majority, the reaction has been only partial, and variable, and comparable with podophyllin and the many other substances which have been reported (e.g. Ostergren, 1944) to contract the chromosomes at metaphase and inhibit spindle formation. Extracts from *Ervatamia angustifolia*, *Aristolochia elegans*, *Euphorbia peplus*, *Bulbine bulbosa* and *Strychnos arborea* gave the most marked and least variable results. Typical c-mitotic action was also obtained with extracts of the exotic species *Gloriosa superba*, *Gloriosa vitiense* and *Crinum* spp.; these plants have been reported to contain colchicine.

The most remarkable results, however, have been obtained with the hydrochloride of the alkaloid cryptopleurine, described from the Queensland species *Cryptocarya pleurosperma* by I. S. de la Lande (1948). This substance in aqueous solution is effective over a range of from 0·5 per cent. to 0·00025 per cent. For periods of treatment up to at least eight hours there is no apparent difference in the activity of the solutions within the range of 0·01 per cent. to 0·0005 per cent. The concentration of the solution does, however, determine the maximum period of treatment after which satisfactory recovery and resumption of normal growth is obtained. Seed germinated in a 0·003 per cent. solution grew roots approximately half an inch in length. After six days' treatment normal mitosis and growth took place when the germinating seeds were well washed.

In solutions of 0·1 per cent., 0·006 per cent., 0·003 per cent. 0·001 per cent. and 0·0005 per cent., which were the dilutions used most frequently, the action on mitosis is as follows. Prophase is normal but the chromosomes contract to a far greater degree in metaphase than is usual. They do not arrange themselves

Figure 1.
Treated 24 hours 0·001 per cent. cryptopleurine hydrochloride. Normal $2x$ number (16) of dispersed and contracted chromosomes at metaphase. Print magnification, x1100.

Figure 2.
Ninety hours after sowing in 0·003 per cent. solution. Division of chromosomes into chromatids. Print magnification, x1100.

Figure 3.
One hundred and twenty hours after sowing in 0·003 per cent. solution. Thirty-two chromosomes in dispersed metaphase, before division into chromatids. Print magnification, x1100.

in an equatorial plate but are generally loosely clumped in the centre of the cell, or they are more dispersed, as illustrated in Figure 1. A varying degree of chromosome elongation takes place before the division into chromatids is evident. The example in Figure 2 shows division a little earlier than is usual. Typical H-shaped figures are rarely formed. Following the separation of the chromatids there is a marked tendency for them to draw apart into two groups, whereupon reversion takes place and a binucleate cell results. Frequently the chromosomes do not divide into two groups and the reversion nucleus becomes tetraploid. In Figure 3, a nucleus in arrested metaphase, with thirty-two chromosomes, is shown. Occasionally the chromosomes separate into three or more unequal groups with the resultant formation of multinucleate cells containing nuclei of different sizes. This happens most frequently during short periods of treatment with strong solutions (0·5 per cent. and 0·25 per cent.).

For cytological purposes cryptopleurine would seem to be an excellent substitute for colchicine.

C. BARNARD.

Division of Plant Industry,
C.S.I.R., Canberra, A.C.T.,
19 April 1949.

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A Phosphatase from Penicillium Glabrum

During the course of some work on the thermal destruction of cocarboxylase, an old solution of the latter was found to contain a white mould. As 90 per cent. of the cocarboxylase originally in the solution was now found to be present as free aneurin, it appeared that the mould was secreting a phosphatase. This class of enzyme has been reported in moulds, but hitherto very little has been recorded in the literature.

The mould was plated on beer wort agar and grown at 20°C. The plate showed *Penicillium glabrum*, *Pullularia pullulans* (present to a much lesser extent), a pink yeast (one or two colonies), bacteria (very few). Of these only the penicillium was present macroscopically in the cocarboxylase solution. This organism, therefore, is quite capable of synthesizing from the air and cocarboxylase all that it requires for the production of mycelium; no spores were noticed. A sterile solution of cocarboxylase inoculated with the penicillium showed visible growth after eight days at 20°C. and progressive hydrolysis of the cocarboxylase to free aneurin (90 per cent. hydrolysis after 21 days). In a similar manner it was shown that the ordinary metabolism of the pullularia and possibly the yeast, involves hydrolysis of the cocarboxylase to aneurin, but to a lesser extent.

Each of the organisms was then grown on beer wort (20 ml.) at 20°C. for 2 to 3 weeks. The contents of the flasks were made up to 50 ml. and Seitz filtered. The filtrates of the moulds but not the yeast were shown by incubation with cocarboxylase to contain phosphatase.

A quantitative measure of the phosphatase activity was obtained by incubating, at 37°C., 5 ml. of cocarboxylase solution (40μg./ml.), 5 ml. of buffer (sodium acetate–acetic acid, pH 4·53), 2 ml. of enzyme solution, and 13 ml. of water. At 0 min. and after exactly 20 min., 2 ml. of this reaction mixture were diluted immediately to 100 ml. and assayed for aneurin by the thiochrome method. This can be done within 10 minutes, and this procedure forms a very convenient method of determining acid phosphatase. If one plots fluorimeter galvanometer reading against the amount of enzyme, a logarithmic curve is obtained, but if a log-log curve, as used for microbiological assays

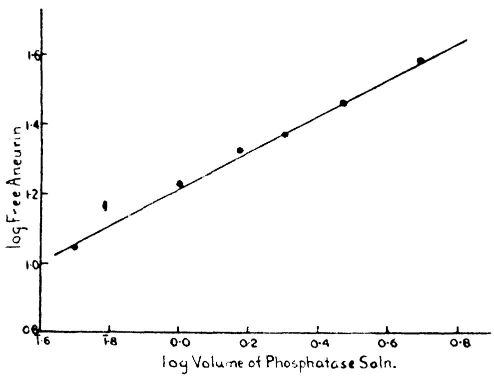

Figure 1.

(Wood, 1947) is employed, a straight line is obtained (Fig. 1). Unknown samples can be related to a standard line and the results returned in, say, 'aneurin units'—which may be defined as that quantity of phosphatase which will liberate 100μg. of free aneurin from excess cocarboxylase in 20 minutes at 37°C., and at the optimum pH of the enzyme. This test cannot be used with alkaline phosphatases because of the vulnerability of aneurin at pH 8–9.

Phosphatase solutions were prepared by growing the moulds in beer wort for 31 days at 20°C. Growth was luxuriant and Seitz filtrates were prepared as above. These were examined by means of the test already described, except that samples were taken at varying time intervals; 2 ml. of the pullularia filtrate were used to demonstrate the unimolecular nature of the reaction. The reaction velocity, k, = 0·012.

It was necessary to dilute the penicillium solution 25 times before satisfactory results could be obtained. These gave the following reaction velocities:

Volume of Diluted (1 : 25) Enzyme Solution.	Velocity Coefficient k.
0·5 ml.	0·0070
1·0	0·0155
1·5	0·0234
2·0	0·0310
3·0	0·0430

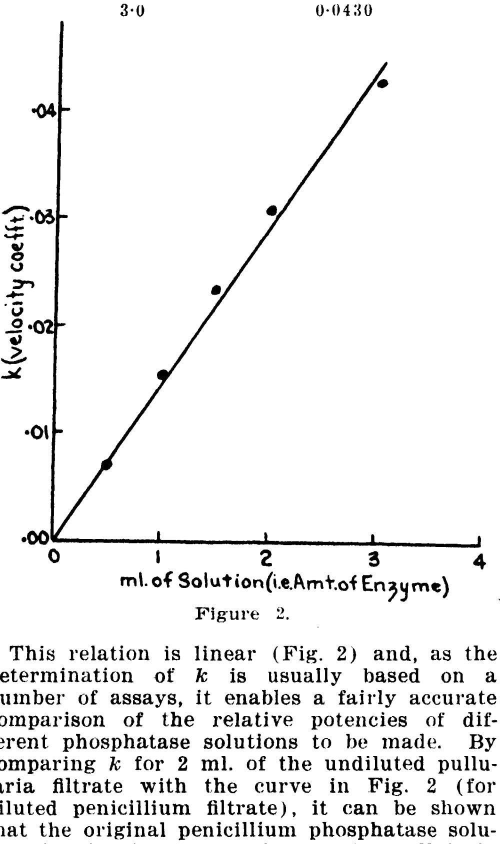

Figure 2.

This relation is linear (Fig. 2) and, as the determination of k is usually based on a number of assays, it enables a fairly accurate comparison of the relative potencies of different phosphatase solutions to be made. By comparing k for 2 ml. of the undiluted pullularia filtrate with the curve in Fig. 2 (for diluted penicillium filtrate), it can be shown that the original penicillium phosphatase solution is 62½ times as active as the pullularia phosphatase prepared under identical conditions. Because of this, no further tests were done with the latter.

To determine the pH optimum of the penicillium phosphatase, the test described was carried out with 3 ml. of the diluted (1:25) filtrate at various pH values. Up to pH = 5·2, 0·6M acetic acid and sodium acetate solutions were used; at pH = 6·15 the buffer was M/2 with respect to potassium phosphate and potassium hydrogen phthalate adjusted with 6N.HCl. All pH values were checked at the end of each test. The results are shown in Figure 3.

Some idea of the activity of the penicillium phosphatase relative to a standard preparation may be obtained by comparison with the phosphatase activity of Parke Davis taka-diastase. Two millilitres of a freshly prepared solution

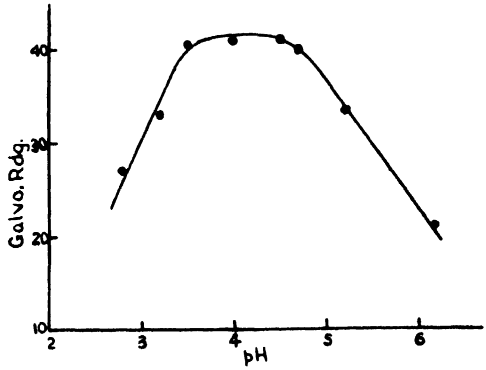

Figure 3.

of taka-diastase gave a reaction velocity for cocarboxylase hydrolysis, k, = 0·0318. From Fig. 2, this is equivalent to 2·12 ml. of the diluted (1:25) penicillium phosphatase solution, so that 1 ml. of the original undiluted filtered phosphatase solution is equivalent to 237 mg. of taka-diastase. On the basis of the 20 minute test, 1 ml. of undiluted penicillium phosphatase is equivalent to 250 mg. of taka-diastase (cf. Fig. 1). If this figure is related to the actual undiluted penicillium medium (20 ml.), then 1 ml. of this is found to be equivalent in cocarboxylase hydrolysing capacity to about 600 mg. of taka-diastase. Even allowing for some deterioration in the latter, it is submitted that *Penicillium glabrum* is a potent source of phosphatase worthy of a closer study than the writer was able to give.

I am indebted to Associate Professor E. I. McLennan, of the Botany School, Melbourne University, for confirming the identity of the moulds; to Miss M. I. B. Dick for growing the moulds; and to Miss W. E. Collard for assistance with the aneurin assays.

K. T. H. FARRER.

Research Division,
Kraft Walker Cheese Co. Pty. Ltd.,
Melbourne,
23 May 1949.

Reference

WOOD, E. C. (1947): *Analyst*, 72, 84.

Distortion of Rectified Radio-Frequency Graphs

The original conductimetric tubes employed for analysis and titration by rectified radio-frequency current (Blake, 1947*a*, 1947*b*), of which several were constructed, were each fitted with a rectifier that was enclosed with the tube within the screening cylinder. In a later design the rectifier was placed in a separately screened compartment. It was then observed that the titration graph for HCl by NaOH, which formerly was linear (Fig. 1, graph B), then became curved (Fig. 1, graph A). As others using this method may encounter the same difficulty, its cause is now explained, and a method of avoiding the distortion is given.

Rectification by metal rectifiers of the 'Westector' type is linear except for a band at the lower end of the characteristic curve. The original arrangement of the conductimetric tube and rectifier allowed the latter to pick up the small amount of radio-frequency current required to reach the straight portion of the rectification curve, so that all the titrations took place in the linear region. It thus appears that a conductimetric set-up which produces curves where there should be straight-line graphs can be corrected by by-passing a small portion of the radio-frequency directly through the rectifier, as in Fig. 2, in which C' is a by-pass condenser having a smaller capacitance than that of the conductimetric tube when filled with solution. The capacity required is approximately 0·000001 μF; this will vary for tubes of different sizes and with different oscillators. It is not critical: it must be of sufficient value to pass over the curved portion of the rectification curve, but not large enough to cause overloading.

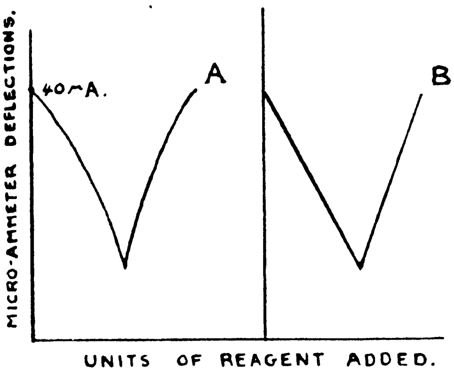

Figure 1.
Graph A shows a HCl by NaOH titration curve distorted by incorrect rectification. Graph B shows the same titration corrected by operating on the straight portion of the rectification curve.

The rectified radio-frequency method of conductimetric analysis and titration has been described in detail (Blake, 1947*a*, 1947*b*). Experience has shown that a standard method of *preliminary* adjustment is required, to simplify the method and to reduce it to a simple matter of routine. With this object in view a number of titrations were carried out on solutions of HCl, by NaOH of various concentrations (0·4%, 0·2%, 0·032% and 0·0083% Moll), and it was demonstrated that, by suitably adjusting the coupling for each of the solutions, all of them could be given the same initial meter deflexion; also that their titration graphs closely resembled one another in size and form. It was apparent that this series of titrations had explored only a small portion of the possible Moll percentage range.

Successful titrations have been carried out with a micro-ammeter having a zero to 60 μA scale, and also by increasing the coupling with a less sensitive instrument having a zero to 500 μA scale. It is wiser, however, to work with currents as small as possible, so as to run no risk of raising the temperature of the solution in the conductimetric tube; it is advisable not to exceed, say, 200 μA. The following procedure is recommended as a preparation for titration.

Preliminary procedure, five minutes after switching on the oscillator:

(*a*) Set the micro-ammeter (or galvanometer) M at zero, by zero-shunt Z. Conductimetric tube empty.

(*b*) Set the micro-ammeter M at 10 μA, by coupling condenser C. Tube filled with distilled water.

(*c*)* Return the micro-ammeter M to zero, by zero-shunt. Tube still filled with water.

(*d*) Set the micro-ammeter at about three-quarters of its full deflexion, say at 40μA, by coupling adjustment. Tube filled with the solution under analysis.

(*e*) Commence titration at that meter-deflexion (i.e., 40 μA).

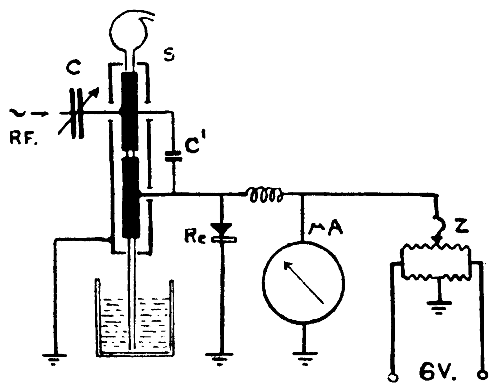

Figure 2.
The addition of a by-pass condenser, C', to the rectified radio-frequency titration circuit. With the exception of the screening cylinder, S, the rest of the necessary screening has been omitted from the diagram.

When once this preliminary procedure has been followed and a titration made, operations (*a*) and (*c*) need not be repeated for successive titrations. It is then only necessary to wash out the conductimetric tube well, fill it with the solution to be analysed, and make a new setting by means of the coupling condensers to bring the meter deflexion to 40 μA. The coupling required to do this will depend upon the concentration of the solution.

G. G. Blake.

Department of Physics,
University of Sydney,
25 April 1949.

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* Operation (*c*) is optional.

Views

Scientists in the Commonwealth Public Service

In the April issue of the JOURNAL are published the views of the Australian National Research Council deploring the proposed transfer of some of the staff of the C.S.I.R. into the ordinary Commonwealth Public Service. I feel that the opinion of one who has worked in this Service for a number of years, that it is by no means impossible to carry out research in the Commonwealth Public Service, may perhaps be given publicity in the columns of the JOURNAL.

I should like first to point out that quite a large number of scientists did, in fact, work under the control of the Public Service Board before the legislation concerning the Council for Scientific and Industrial Research was enacted. Besides the small number in the Commonwealth Observatory, scientific officers worked subject to departmental control in the Postmaster-General's Research Laboratory, in the Bureau of Mineral Resources and in the Meteorological Bureau, to name no others. The large number of scientific workers in the old Munitions Supply Laboratories (now Defence Research Laboratories) worked under esentially similar conditions but were not under the control of the Public Service Board. What I now wish to say is not in any way supposed to represent the view of any officers in these organizations, but is personal.

The A.N.R.C. suggests that conditions affecting staffing and establishment are likely to deteriorate consequent upon a change from the old-type C.S.I.R. control to normal Departmental control. It is true that until very recently C.S.I.R. officers got more pay and quicker promotion than scientific officers in ordinary departments, and the quicker promotion was due in part at least to the elasticity of 'establishment' in the C.S.I.R. I do not suppose that any individual in the C.S.I.R. will lose financially by transfer to Public Service Board control: future appointees may possibly get less than existing staff transferred. We outsiders hope, quite naturally from our point of view, that financial parity between all scientific officers employed by the Commonwealth will now be established and maintained. But surely this issue is a domestic one among Commonwealth employees, and hardly a matter for grave national alarm?

Under the same heading the A.N.R.C. criticizes the Appeal System. Appeals are not commonly made by scientific employees, and, if the Director who made an appointment which is specifically appealed against cannot justify his choice on the grounds of superior efficiency of the man originally promoted compared with that of the appellant, then the promotion should never have been made.

The A.N.R.C. further supposes that this change-over to departmental control will have adverse effects on scientific work itself and create 'dangers of interference in policy and direction at high level'. I believe that the idea commonly entertained by persons outside the Public Service—that departmental control must necessarily hamper scientific research—is quite false. In particular, one may question whether it is possible to quote a single example of Ministerial interference with any scientific research activity, except on the grounds of economy (a form of control which is absolutely necessary, and is really present in all forms of State-aided scientific work, including State-aided university research) or secrecy on matters directly affecting defence. Does the A.N.R.C. really advocate removal of Cabinet control in the latter case?

My experience has shown that a research establishment is extremely free under the Department of Interior. If it is suggested that my experience is very peculiar as I am an astronomer, the details of whose work are not likely to provoke Ministerial interference, I ask whether any responsible person really supposes that any Minister is likely to interfere personally in the research work of, for example, either the National Standards Laboratory or the Radiophysics Laboratory, except if the expenditure is thought to be excessive? (In passing, one may note that a good deal of their current research work is closely allied to Solar Physics and even to Astronomy.) I draw a distinction between research activities on the one hand and applied and defence science on the other. Surely one must agree that, where the latter are concerned, public policy must be closely controlled by a Minister of the Crown.

One can agree with the A.N.R.C. that it is in general most undesirable that the details of research programmes should be controlled by administrative officers, and not by working scientists; but I do not know that the Commonwealth Public Service is a notable offender in this respect. Some very careful thinking is needed on this point. It is common experience that, in far too many cases, working scientists become in fact administrators in middle life, and it may be asked whether this is really desirable. It is accepted theory in the Commonwealth Public Service that, as far as possible, the administration is carried out in a central office and the actual scientific work is pursued in the special branch set aside for it; and it may not be too much to claim for the Commonwealth Service that this theory is translated into practice as far as the nature of the case permits.

Of recent years it has been very difficult for private endowment to finance scientific research on an adequate scale, and in most countries the State has had to step in to enable the work to continue. One may see no reason to regret this change on political grounds, and probably most Australians will hold the view that it is better for the public

to pay for research than for private individuals or concerns to do so. Actually the Commonwealth of Australia is not backward in providing funds for research. (The Commonwealth Observatory, with which I myself am connected, has been treated very generously.) It is now necessary for the Public Service to provide means for the proper control of the public expenditure incurred in this way, including the supervision of conditions under which the staff work and the rates which they are paid. In my own experience I have found that the Public Service Board recognizes that it has an obligation to exercise specialized control over scientists in contrast to typical public servants, and that there has been a change in the attitude of the Board towards the subject during the years in which I have worked in the Commonwealth Service. While not giving away any of the points which some of us are claiming through the Professional Officers' Association, I think it is only fair to say that the present Public Service Board has a proper appreciation of conditions under which a scientific organization can be successfully built up.

May I conclude this letter by appealing to those who criticize the Commonwealth Public Service in its administration of research to examine the actual record and to pay less attention to preconceived ideas of how the system works?

R. v. d. R. Woolley.

Commonwealth Observatory,
Mount Stromlo, A.C.T.,
10 May 1949.

Scientists and Publicity

Scientists, as a rule, do not love publicity. This is as it should be—'In science we must be interested in things, not in persons', Madame Curie is reputed to have told an inquisitive newspaper reporter.

A distinction must, however, be drawn between publicity for scientists as individuals and publicity for scientists as a group with special responsibilities, problems and methods. Since the work of scientists, on the whole, sooner or later influences the world's affairs—and since the scientists must be affected by the actions, opinions and conditions of the community around them—some effort is required to give the community an idea of what scientists do and think. It is desirable that scientists should use every chance to present some of their opinions, as well as some of their difficulties, to the public. Such chances are rare, and it is a pity to waste those which occur.

Good opportunities to put on show some of those problems which scientists face outside their laboratory research were lost in the two recent scientific congresses, held at Hobart and Auckland respectively. In neither case was the publicity value of a gathering of distinguished scientists exploited as fully as it might have been, for the benefit of *scientists in general*. Certainly, statements about new gadgets, drugs and bombs found their inevitable places in evening newspapers and radio 'flashes'; but the far wider problems which Australian scientists face today—lack of funds and facilities, difficulties associated with restricted interchange of information, their function in advising the community on its needs, the place of fundamental research—these problems received scant attention. Yet we cannot expect governmental grants for university research if the average taxpayer does not realize the significance of 'research'. Neither can we expect the man-in-the-street to believe that there may be 'a scientific approach to problems of human conflict' (one of the symposia at Hobart) if he does not realize the importance of having people who can *think*, as well as produce vaccines and jet engines.

During the Hobart conference of A.N.Z.A.A.S. the prestige value of a scientific congress might have been used to draw attention to something more than the mere tricks of science. The lack of funds for research and teaching in the universities, for instance, was admittedly discussed by the General Council of the Association; but, instead of being made the subject of a strong joint statement of the Council to awaken public interest, the matter was shelved, to be discussed later (and in private) by a higher body. The wisdom of leaving action to the higher body is not questioned; but a resolution from these, the collected representatives of scientific bodies in Australia and New Zealand might (particularly if pushed) have penetrated to the newspapers, might have stimulated public interest just a little—and when public interest is aroused, official support is brought one step nearer.

It is further suggested that better use might possibly have been made of available material at Hobart and Auckland. One might question the necessity of using newspaper space for a list of the names of the speakers for the day without further details; and as a further example one might mention the rather unsatisfactory 'cover' given to the important and interesting symposium mentioned above, when, of the two speakers, one (who spoke *ex tempore* and had thus presumably not handed in a statement beforehand) was not reported at all.*

It is felt, then, that it is necessary for scientists to make more imaginative use of their public occasions; to use them to attract public attention to the jobs which scientists do and to the problems which they face. This requires, as stated, imagination in the handling of publicity material and a close liaison with the Press. If these existed, then their results

* See This Journal, *11*, 125 (1949). Reported from longhand notes taken while standing throughout the symposium, at the back of the gallery.

were not very apparent at Hobart or, as far as one could judge in Sydney, also in New Zealand. If a false view—or no view—exists regarding the place of scientists in the community, then the fault is, at least partly, in their own hands to remedy.

ELISE SELLGREN.
J. T. BISHOP.
H. C. FREEMAN.

Sydney University Science Association,
University of Sydney,
23 May 1949.

National Security

Squadron-Leader A. D. Thomas, in his article on 'National Security' (This JOURNAL, *11*, 152) sets out to show the need for certain restrictions on the free exchange of scientific information because of the international situation. This need, as far as it refers to the development of weapons of war, and not to fundamental research, is generally accepted; and there seems to be no purpose in putting the case at such length unless to include the latter, and to justify recent governmental acts that have aroused grave misgivings among scientists.

Squadron-Leader Thomas rightly informs us that 'it is incumbent upon us, as scientists, to view the question objectively'. There are, however, reasons to doubt if he himself has followed that course. He refers to 'the gravity of the situation'; to 'powerful forces elsewhere' which threaten the world; to Australia's 'peril of attack by an aggressive foreign power—not necessarily today, but during the next decade or two'. Can we as scientists accept these as statements of objective fact without further investigation? There appears no evidence of their justification, other than as a mere record of personal belief.

It may reasonably be surmised that in the writer's mind the 'aggressive foreign power' is Russia. While perusal of the daily Press may easily give rise to this belief, it would surely be naïve to take such as adequate scientific evidence. That it is possible to approach topics of this type objectively, and reasonably scientifically (not in vague generalities, but specifically and concretely), is shown by Blackett (1948), who has analysed carefully and at some length the position in relation to atomic energy. Though limited somewhat by this special aspect, his conclusions are relevant here. In discussing the possibility of atomic bomb attacks he writes (page 68): 'One must now inquire what reasons the Soviet Government would have for launching an atomic attack on America. One can find none.' Later (page 162), he concludes: 'All these arguments reinforce the view that Soviet Russia will be very careful to avoid precipitating a military show-down, while at the same time will do her best to increase her defensive strength'. The belief that Russia has no aggresive intent is shared by many responsible people in Britain and the United States, according to Press reports from time to time. For example, Dulles is reported as saying that Russia did not now plan conquest by open military aggression, and that he did not know of any responsible official, military or civilian, in the United States or any other Government, who believed Russia had such plans. (*Sydney Morning Herald*, 9 March 1949, *1*.)

Further, it is fairly clear that an attack on Australia would meet formidable difficulties of bases and supply. It may be concluded that there is no danger of an attack on Australia in the foreseeable future, unless with at least the tacit approval of the United States.

In the recent war, Australian scientists showed that they were fully aware of the need of their services, and they took the initiative in offering help in the defence of their country. The Government has freely acknowledged that there was no breach of trust, and no need was felt to impose unusual restrictions on their activities or to tamper with the C.S.I.R. or other scientific institutions. The fact that the Government has deemed these measures necessary now, during peace, suggests that it has little confidence in securing willing support from scientists. Since, then, Australia is patently not threatened by any nation, it may reasonably be doubted if these measures are in fact really related to defence or if they are not related to much less acceptable aims.

Squadron-Leader Thomas has succeeded in reaching his conclusion only by accepting as axiomatic a dubious premise. On this basis he apparently wishes Australian scientists to accept gladly, or at least with good grace, serious curtailment of scientific freedom for many. To do so would, however, be tacit approval of preparation for a war that is in the interest neither of the scientists nor of the people of Australia.

R. C. TRAILL.

Kew, Victoria,
23 May 1949.

Reference

BLACKETT, P. M. S. (1948): *Military and Political Consequences of Atomic Energy*. London: Turnstile Press.

Reviews

Fish

THE WAYS OF FISHES. By Leonard P. Schultz and Edith M. Stern. (London: Macmillan & Co.; New York: D. Van Nostrand, 1948. 264 pp., 80 text-figs. 6″ × 9″.) English price, 22*s*. net; American price, $4.00.

This excellent book may well be calculated to upset the non-zoological person's conception of what fish are—or rather what they can do. Although frankly in the natural history class (and we could do with more, modern,

books of this type), the scientific standing of its authors is sufficient to guarantee its authenticity.

Some idea of the background may be gathered from the Preface:

> 'There are forty thousand different kinds of fishes, nearly twice as many as the varieties of birds, mammals, and amphibians — all the other vertebrates — put together.
>
> 'Individually they are innumerable, the most abundant form of vertebrate life found either around the shores or in the fresh waters of all the continents and the islands on the globe. They live from down in the depths of the sea to up above the timber line on high mountains. Some are at home in the 109-degree temperature of a hot spring; others flourish in the near-frozen waters of Arctic and Antarctic Oceans.
>
> 'Adult fishes range in length from one-third of an inch to more than forty-five feet; in weight from two or three grammes to twenty-two tons. Their coloring is as varied, brilliant, and beautiful as that of butterflies—and some glow with a luminescence lovely and enchanting.
>
> 'Not all are creatures who can exist only in water and move only by swimming. Some walk, some fly; some breathe air, some water. There are fishes with eyes divided somewhat like the bifocal lenses of spectacles, for different uses; the upper part for vision in air, and the lower for vision in water.
>
> 'Some of them have habits resembling those of humans. There are fishes, for instance, as strictly vegetarian as members of a non-meat-eating religious sect; others catch their dinners with fishing rods. The habits of other mammals too have their counterparts. There are fishes that burrow like moles, hibernate like bears, and fight like tigers . . . .'

The first chapter, on migration, is devoted almost entirely to the fresh-water eel and the salmon. The remarkable eel story is given in some detail—the patient researches of the Dane, Dr. Joh. Schmidt, extending from the year 1906 till the time of his death in 1933; his ingenious plan of enlisting the co-operation of liner-captains in making plankton catches over wide stretches of the Atlantic; and the final location of the breeding place of the European fresh-water eel, three thousand miles away near the Sargasso Sea. Then they describe the three-year journey of the small glass-like leptocephali back across the Atlantic to their home coasts, their transformation into elvers, and finally into adult eels which move up into fresh water. Here they remain for five, ten, or twenty years before they too get the urge to migrate to their breeding place on the other side of the world.

One of the most interesting chapters in the book is the one devoted to fishes that are dangerous to man, and perhaps the chief villain of this section of the story is the bloodthirsty *piranha*. This is an eight- to twelve-inch fish of somewhat the same shape as the Australian bream, which inhabits fresh-water streams and lakes of eastern and central South America. The *piranha* has triangular teeth which close over one another like the blades of a pair of pruning shears, and they are so sharp that the Indians of Guiana use them, mounted, as knives or arrow points. The *piranha* hunt in packs like wolves, and the smell of blood seems to send them mad. The authors relate the story of a sixteen-year-old boy in British Guiana who was in swimming and who 'was heard to scream, first in fear and then in agony. Before he could be rescued, he disappeared below the surface, and all that was recovered a few hours later was his skeleton. *Piranha* had literally eaten him alive'. Cattle and horses have also been attacked while crossing streams, and stripped right to the bone. The authors remark that 'indeed there is nothing pleasant about this fish until it is dead. Then it makes very good eating'.

Much smaller in size, but possibly more macabre in some ways, than the *piranha* is an eel-like South American catfish known locally as the *candiru*. This three-inch-long fish has the disconcerting habit, not only of attacking swimmers, but also of entering their sex organs. To quote the authors again, 'to urinate in any of the waters they inhabit is to tempt fate, for they are strongly attracted by any current. Entering the penis or vagina, they may penetrate well into the urethra. There, unable to turn, and in the throes of suffocation, they erect their fish-hook-like spines. Their unwilling hosts, writhing in unbearable pain, are lucky if they can be rushed to hospital in time to have their lives saved. The parasites can be dislodged only through an operation. In some cases on record the whole organ had to be removed.'

The authors register a mild protest about the exaggerated idea the public has on the subject of the fierceness of sharks. They say that, contrary to popular belief, sharks are naturally cautious and timid. In fact, one individual offered a reward of five hundred dollars for an authentic case of a shark attack along the Atlantic coast north of Cape Hatteras and the reward was never claimed. Still they do record about a dozen shark attacks, most of them in the Florida and West Indian regions; and also mention that G. P. Whitley, of the Australian Museum, Sydney, lists almost 150 casualties from shark attacks in the tropical and temperate waters of Australia.

In the section on locomotion in fishes, they give some interesting figures on the air-borne performance of flying fishes. After an initial 'taxi run' through the water, during which the speed may rise to forty m.p.h., the fish takes off into the wind, opening out the

enlarged pectoral fins and holding them rigid like the wings of an aircraft. The flight is purely a gliding one, and a fish has been observed to remain air-borne for forty-two seconds, covering in this time a distance of 1200 feet, at heights above the water ranging from twenty-five to thirty feet.

In contrast to this unfettered mode of progression is the Siamese walking perch which, through possessing a special type of breathing apparatus, is able to take oxygen straight from the atmosphere—in fact, if it is forcibly held submerged, even in well-oxygenated water, it will drown. Its respiratory method enables it to spend a considerable time out of water, and it actually walks propped up on its pectoral fins, the locomotor effort being derived from wriggling movements of the tail. The gait is very slow and awkward, but even so they can walk for considerable distances. They may be found at night, crossing dusty roads and dry fields. One specimen which was being transported from its pond to a nearby stream, escaped from the basket *en route* and made its way back to the pond. The observer watched it pass through grass, over a metalled highway, between houses, and through flower beds until it reached its original home. The total distance covered was a hundred yards, and at a rate of ten feet per minute.

Of very great interest to the physiologist are those fishes that can generate considerable amounts of electricity in their bodies. There are four distinct types that have this ability. The electric eel from the rivers of South America and Africa; the electric ray (common in Australian waters); the electric catfish from the rivers of Africa; and the stargazer, a small marine fish.

In an account of the attempts to measure the electrical output of electric eels in the aquarium of the New York Zoological Society, the authors describe how early endeavours were foiled because the violence of the discharge burned out the instruments. Eventually a special form of cathode-ray oscillograph was evolved which enabled measurements to be made. An eel about a yard long attained a maximum voltage of 450 to 600, and an eight-foot specimen produced very little more than this, although the wattage was considerably higher. It was found that whereas the usual wattage was in the vicinity of 40, the experimenters could draw almost 1000 watts without disturbing the fish in the least. Putting it in a rather different way, 'a fish four feet long and five to six inches in diameter has a power pick-up several times that of an ordinary automobile, and any average electric eel of three feet or longer has a power pick-up of about 150 h.p. per second, a fact which seems to belong to the *Believe It or Not* class'. The discharges, though, have passed and gone in about one five-hundredth of a second, and so are incapable of lighting an ordinary electric bulb, which requires ten times this period to light properly.

It must not be thought that the book is just a collection of sensational facts about fish. There are good solid chapters on such diverse topics as the giants and dwarfs of the fish world (there are some pretty startling figures here actually); fish that build nests in streams; fishes controllable by man; fishes that fight; home aquaria, and fishes suitable for them; while the concluding section of the book is devoted to a very complete list of fish families, fossil and living. How one wishes that the authors had been able to include in this a key showing the characteristics of these families! They would have earned the universal gratitude of zoologists (the reviewer included), who for some years have been waiting for such a key.

One notable feature of this book is the simple, clear illustrations in line and stipple. The authors have put their main effort into the text, and have resisted the temptation to provide large numbers of beautiful photographs, letting these carry the book themselves. So many contemporary works in the field do suffer from this fault. The photographic illustrations may be magnificent, but the text is not always of the same high standard.

To the reviewer's mind the chief value of this book lies in the fact that it includes between its covers a widely-varied series of facts about fish, which normally could be found only in a number of separate publications; he suggests that it might well be added to the reading list of senior zoology students who have been rather dashed by the dull classical approach to the fishes as a group.

A. N. Colefax.

Colloids

Colloid Science. Vols. I and II. By A. E. Alexander and P. Johnson. (Oxford: University Press, 1949. 837 pp., many text-figures and tables, 4 appendices. 6″ × 9¼″.) English Price, £3 net.

The subject of colloid science has grown, in the last half-century or so, from a set of disconnected observations, related to phenomena touched upon by certain branches of physics, chemistry and biology but adequately treated by none, to a science with a literature of its own almost as extensive as those of the parent sciences. Like the several other subjects which have arisen in like manner, developments in colloid science have taken place along two main lines. One group of investigators have attempted to co-ordinate existing phenomena in a unified theory, and therefore have on the whole proceeded along converging paths. Simultaneously other investigators have been more concerned in the development to pragmatic ends of the relations revealed by academic studies, and have on the whole proceeded along diverging paths. As a net result there has been a steady increase in the range of subjects, particularly those of a technical nature, covered by the study of colloid science.

That there has been, in recent years, an overall unification of the principles involved in colloid science, and this in spite of an incessant demand from technology for more facts and 'know-how' at any price, is due in no small measure to the activities of the various research schools in colloid sciences established in universities throughout the world. In the years from 1931 to 1946 the Colloid Science Department, at the Royal Institution, London, under the guidance of Professor E. K. Rideal, has grown to one of the best known of these. Both the authors of the book under review have been trained in it.

As there has been established no traditional standard method of presentation in the subject of colloid science, the authors have of necessity had to devise their own. That they have, by and large, been successful is attested by the satisfactory nature of the subject arrangement, in which the reader is on few occasions, only, referred *forward* to later chapters for a proper appreciation of the significance of the matter in hand.

The book is divided into three parts. Parts I and II together make up Volume I, Part III makes Volume II. In Part I there are three chapters which are mainly historical and give a survey of the major developments from the pre-scientific era right up to modern times. The two other chapters in Part I are of general theoretical interest. One is devoted to thermodynamics and the other to the theory of electrolytes. Both of these are subjects which, while not an integral part of colloid science, are essential in any theoretical treatment of it.

Part II is divided into two sections. The first eleven chapters are concerned with experimental methods for the study of colloidal systems, and the last three with the study of the interface between chemical phases. The writers, in discussing the experimental methods, are concerned principally with those which will give information on the size, the shape, and the effective molecular weight of the particles which make up the various colloidal systems. The methods reviewed include analysis for trace elements or groups; studies of osmotic pressure, of sedimentation in the ultracentrifuge, of translational and rotational diffusion, of sedimentation velocity, of electrophoresis and other phenomena associated with surface electrification, of viscosity, of rheological properties, and of the use of optical, X-ray and electron-microscope techniques.

The three chapters on studies of the interface are concerned with all of the many developments of surface physics and surface chemistry which have taken place in the last two decades; with measurements of the surface spreading force, surface potential and the equation of state of two-dimensional systems. The different types of surface films are given, with methods of studying them, and applications to biological systems. The properties of films on the solid-fluid interface, and techniques for the study of this interface, are given in outline. In view of the enormous technical importance of systems of this nature, the treatment of this section might have been somewhat expanded without unbalancing the treatment of the subject as a whole.

Part III, or Volume II, is concerned with a systematic treatment of the properties of the principal colloidal systems. The systems considered are sols, gels, pastes, foams, emulsions, soaps, dyestuffs and other colloidal electrolytes, clays, zeolites, proteins, polymers and membrane materials. The preparation, structure, stability, main physical properties, and technical applications of each of these systems are considered. To those mainly interested in the applied, or divergent, aspects of colloid science, Volume II may appeal as the more immediately useful of the two. It makes difficult reading, however, without the background provided by Volume I or some equivalent study.

The two volumes will be welcomed for making an authoritative treatise available in a thoroughly readable form. The two authors are to be congratulated on their success in bringing to order an immense array of material covering widely different theoretical and experimental techniques. The technical aspects of the production are in the best traditions of the Oxford University Press, the text and diagrams being admirably presented. One minor criticism is that the index is very incomplete and is to be found only at the end of the second volume—which makes the book less useful for reference purposes. As the volumes are clearly meant to be read rather than consulted, this is perhaps an insignificant blemish.

R. C. L. BOSWORTH.

Eggs

THE AVIAN EGG. By Alexis L. Romanoff and Anastasia J. Romanoff. New York: John Wiley and Sons; London: Chapman and Hall, 1949. 918 pp., 424 text-figs. (6″ × 9″.) Price: $14.00.

In 1931 the science of Chemical Embryology was, to all intents and purposes, brought into existence as a body of organized knowledge by the publication of Needham's monumental work of that name. It was evident from that book that the bird's egg had already played an important part in the development of the science, providing easily obtained material which could be used in the study of many aspects of embryonal metabolism. Alexis Romanoff, who shares with Anastasia J. Romanoff the authorship of the work here reviewed, is Professor of Chemical Embryology at Cornell University, and it is evidently his interest in this subject which chiefly moved him and his colleague to the great labour of preparing the book. The scope of the work, however, extends far beyond the bounds of Embryology, and indeed of Biology, embracing the whole field of our knowledge of the

unincubated egg. In spite of its encyclopaedic character, it is pleasantly written and easy to read.

Part I of the book deals in five chapters with the formation, structure and laying of the egg. Amongst much of value, it is difficult to pick out particular parts for mention, but it was especially pleasing to find a careful account of such matters as the structure of the shell and shell membranes, of the albumen, of the histological structure of the oviduct (the illustrations of which might surely have been larger), and of cytological and chemical changes in the developing oöcyte. The last chapter of this section deals interestingly with anomalies, such as double yolks. One author, presumably of an earlier century than this, claimed to have found in an egg 'a human-faced monster with hair and beard of serpents'! Embryology must have been full of surprises in those days, as indeed it still is.

The second part of the book deals with the physico-chemical properties of the egg. Besides treating such obvious matters as chemical constitution, the authors deal with other less-frequently discussed topics, such as breaking strength, and the refractive indices of yolk and albumen. The last chapter of this division deals with the 'biological properties'. These include the microbiology of the egg, the hormones and enzymes contained within it, the enzymatic hydrolysis of albumen and yolk, their immunological properties and a number of other interesting matters, such as the physiological effects of injected albumen. This section will be an invaluable work of reference in all laboratories in whose work eggs play any part.

The third and last section is devoted to matters of 'bio-economic importance', discussing food values, preservation, and industrial uses. It should be welcome to all practical egg users, from large industrial concerns making powdered eggs to the housewife (who is reminded, for example, that before boiling a water-glass egg she should prick its air sac). There is an interesting discussion of 'candling' as a method of examining eggs, and a long section on the preservation of eggs by all the known methods. The chapter on industrial uses tells us of the part played by eggs in cake-making, ice-cream, macaroni, salad dressings; of its use in medical research, in tanning leather, in making artists' materials, cosmetics; and in many other processes. The book closes with a short account of the egg in popular arts, and a suggested design for a mosaic made of coloured bits of eggshell.

There is a bibliography of rather more than 2,500 references, selected from nearly 15,000 which the authors had reviewed. There is a well-classified index. A useful feature is the diagrams, several of which are designed as summaries of considerable parts of the book. One, fig. 72B, purporting to represent a surface view of an unincubated blastoderm, is surely an error, for it shows a primitive streak in a pear-shaped *area pellucida*. Most embryologists would probably agree that this would be unlikely unless the egg had been incubated for several hours.

The authors begin their preface, which is of admirable brevity, with the sentence 'This book represents an attempt to compile all the facts known about the bird's egg'. It is scarcely conceivable that they could have achieved this, even in a book which is more than 800 pages long (without the index and list of references), and even allowing for the limitation of their scope to the unincubated egg 'before the activation of the life within it'. (This, incidentally, is inaccurate, for the 'life within it' is activated long before the egg is laid—when, if it has been fertilized, the development of the embryo has already begun.) Nevertheless, the scope of the work is remarkable and its thoroughness is impressive in the extreme. Zoological readers might wish for a more complete discussion of the relation between the pigmentation of birds' eggs and their environment, and probably all readers will hope for another edition, or another book, dealing with the changes in egg constituents during the development of the embryo. This, however, is to say that the chief fault of the book is that there is not more of it; and there are already 918 pages. It is a very good book indeed.

P. D. F. MURRAY.

Agriculture

GROWTH SUBSTANCES AND THEIR PRACTICAL IMPORTANCE IN HORTICULTURE. By H. L. Pearse. (Commonwealth Bureau of Horticulture and Plantation Crops, Technical Communication No. 20, 1948. 233 pp.) Obtainable from C.A.B. Liaison Officer, 314 Albert Street, East Melbourne, C.2, Victoria. Price, 15*s*. 8*d*.

Dr. Pearse has brought up to date his review of information on the use of plant hormones, which was published in 1939 as Technical Communication No. 12. This new review of the rapidly expanding knowledge of growth substances will be valued by research workers and students in agricultural science as well as by practical horticulturalists and landholders.

It deals adequately with the history of the new developments. The use of growth substances in vegetative propagation is covered in detail and is strengthened by the inclusion of an index of seventy-eight pages listing typical results obtained with cuttings of various species. Sections are devoted to the treatment of seed and seedlings, and the treatment of growing plants. The use of growth substances in inducing parthenocarpic development of fruits is dealt with at length. The interesting results obtained with tomatoes and a number of other fruiting plants are described, together with notes on other aspects of these treatments. The chapter on the use of

growth substances as selective weed killers is of particular interest to Australian agriculturalists generally. Questions of the prevention of sprout development in potatoes, and the retardation of flowering to escape frost injury are dealt with comprehensively. The text is supported by a comprehensive bibliography.

A CATALOGUE OF INSECTICIDES AND FUNGICIDES. Volume II, Chemical Fungicides and Plant Insecticides. Compiled by Donald E. H. Frear. (Waltham, Mass.: Chronica Botanica Co.; Melbourne: N. H. Seward Pty. Ltd., 1948. 153 pp., paper covers.) Price, $5.50.

Volume Two of this catalogue is arranged along similar lines to the first volume (reviewed in This JOURNAL, *11*, 34), but deals mainly with the chemical and other fungicides, with a concluding section on insecticides of plant origin. The chemical fungicides are arranged according to the somewhat involved coding system previously discussed, rather than alphabetically, the objective of the author being to list together compounds of related composition. This arrangement has much to commend it, although the coding system, by which the classification was achieved, is cumbersome to use for purposes of reference. The volume contains, fortunately, an alphabetically-arranged index to compounds listed in both volumes, which will greatly assist most entomologists and plant pathologists. A reference and author index, and a patent list, are contained in Volume Two, as in Volume One.

Considered together, the two volumes provide by far the most comprehensive reference lists of insecticides and fungicides yet published, and should have a place in the library of any institution undertaking either research or advisory work in fields where insects or fungi are destructive agents. The catalogue is a remarkable compilation which gives the chemical composition or origin of all, or almost all, insecticides and fungicides; a grading of their toxicity to specific organisms; references to the literature concerning them; and patents, if any, which cover them. The author states that every effort has been made to make this catalogue as complete as possible up to January, 1944, and that special attention has been given to gathering information on the less-commonly used materials.

C. J. MAGEE.

Biochemistry

BIOCHEMICAL EVOLUTION. By Marcel Florkin. Translated by Sergius Morgulis. (New York: John Wiley and Sons; London: Chapman and Hall, 1949. 157 pp., 25 text-figs. 6″ × 9″.) Price, $4.00.

This edition of Professor Florkin's book differs little from the original French volume (*L'évolution biochimique*, 1944). The author sets out to show that 'evolution and the classification of animals can be considered from a biochemical viewpoint; in other words, that systematic biochemical characteristics exist'. If it is meant that these characteristics, without support from other studies, allow us to obtain a useful phyletic arrangement, then the book has failed to fulfil its aim. However, if the meaning is that biochemical findings can and do confirm or elucidate the essentially morphological phylogeny at present in vogue, then this book succeeds, presenting, in slightly more modern form, the ideas developed in similar monographs by J. Needham and Baldwin.

Modern work on biochemical genetics demonstrates very neatly that evolution can proceed at a biochemical level, but in the reviewer's opinion the data of comparative biochemistry so far accumulated cannot do more than act as a support for already existing classifications. Dr. Morgulis' statement in the Translator's Preface that 'very few biologists and still fewer biochemists or physiologists are probably alive to the existence or the deep meaning of this relationship' (that is, between biochemistry and evolution), does little justice to the readers of texts and journals on comparative biochemistry or physiology.

The seven chapters are set out under the following headings: Unity of the Biochemical Plan of Animals, Dissimilarities, Evolution of Biochemical Constituents, Orthogenetic Evolution of Biochemical Systems, Biochemical Adaptations, Systematic Characters and Perspectives.

Specific criticisms can be levelled against the sections dealing with the replacement of cytochrome by other pigments in the lower animals (p. 22); the statement that in the invertebrates non-haem oxygen-carriers are more common than hæmoglobin (p. 29); the lack of treatment of Bergmann's contributions to sterol phylogeny; and the omission of a section on intermediary carbohydrate metabolism.

Despite these deficiencies, Professor Florkin has written a stimulating account of the biochemical activities of the various groups of animal organisms; an account which should be read by all workers in these fields and one which will suggest many problems for future work.

GEORGE HUMPHREY.

BIOCHEMICAL PREPARATIONS. Volume I. Herbert E. Carter, Chief of Editorial Board. (New York: John Wiley and Sons; London: Chapman and Hall, 1949. 76 pp. 6″ × 9″.) Price, $2.50.

For a long time there have been two series of publications, *Organic Syntheses* and *Inorganic Syntheses*, designed to provide accurate information about chemical methods. A group of investigators in U.S.A. recently decided to organize a similar cumulative reference series

to present information about compounds of biochemical interest. This volume, the first, contains information for the isolation or synthesis of sixteen substances. The formation of this series is to be kept very similar to that of *Organic Syntheses*, and it is intended to issue the volumes at the rate of one every twelve to sixteen months. A very useful section of this first volume is the list of references to fifty-eight relevant preparations which have appeared in the first twenty-seven volumes of *Organic Syntheses*.

The substances considered in the volume include adenosine di- and tri-phosphates, L-alanine, L-serine, casein, diphospho-pyridine nucleotide, the a-glucose-1-phosphates, L-glutamine, DL-glyceraldehyde-3-phosphoric acid, lycopene, L-lysine, lysozyme and D-tyrosine. In each instance the method has been worked out by an experienced investigator in the relevant field, and a check on the methods made by workers in other laboratories. Key references are provided for alternative methods and other relevant information. This series will quickly become an essential purchase for libraries catering for the needs of research workers in biochemistry.

J. L. STILL.

Botany

VERNALIZATION AND PHOTOPERIODISM — A SYMPOSIUM. Lotsya Series, Volume I. By A. E. Murneek and R. O. Whyte. (Waltham, Mass.: Chronica Botanica; Melbourne: N. H. Seward, 1948. 195 pp., 26 text-figs. and illustrations, 19 tables, 12 plates. $7\frac{3}{4}'' \times 10\frac{1}{2}''$, card covers.) Price, $4.50.

This symposium, like so many, suffers from insufficiently firm control by an editorial hand. Indeed, the title page bears no editor's name—Whyte and Murneek wrote the two lengthiest contributions, but bear no further responsibility, and one presumes that Dr. Verdoorn, the editor of the Series, also edited this volume. A symposium is generally most useful where the contributors have been 'briefed' in such a way that the whole of the subject is covered without important gaps or overlaps; where the general conception of all the articles is similar; and where the style and presentation are reasonably uniform. These things cannot be said of the present volume: the various articles overlap considerably, and the effects of photoperiod on growth and vegetative development are quite inadequately covered; the contributions range from original accounts of experimental work through speculative papers to straightforward and rather uncritical reviews; and uniformity is limited to typography and physical lay-out.

The first two articles, by Whyte and Murneek, are historical reviews of research on vernalization and photoperiodism respectively. There follow nine papers on miscellaneous special aspects of these topics; and the book concludes with three 'Special Supplements', each being a reprint of a paper originally published in a German war-time or post-war journal. Two of them have been furnished with addenda to bring them up to date.

To the reviewer, the supplements were perhaps the most interesting part of the book. Australia, more than most countries, has been starved of German scientific periodicals for ten years, and this opportunity to read papers otherwise difficult of access was most welcome. The ideas put forward in one of Bünning's papers—that plants develop a metabolic rhythm independent of current environmental conditions, and that photoperiodic responses depend upon the phase in this rhythm obtaining at the time that the treatments are applied—are rather remote from those current among workers on the subject elsewhere, and it is unfortunate that the paper was not rewritten in such a way as to include more of the experimental data on which the ideas were based. Lang's paper, with its numerous examples of monofactorial inheritance of flowering behaviour, was also of considerable interest.

Of the shorter articles in English, forming the bulk of the book, that by Sircar—a straight review of Indian research on the subject—is worthy of mention because the work with which it deals, considerable in volume though in the main rather empirical, is not well known outside Asia. Allard has contributed some interesting speculations on photoperiodic response as a factor limiting plant distribution and migration in past geological ages; but the reviewer finds it difficult to take these suggestions seriously, for, unless one postulates very sudden changes in day-length which could be brought about only by astronomical cataclysms, it seems likely that mutations in the simple groups of genes responsible for photoperiodic behaviour would arise sufficiently frequently to prevent this being an important factor in the distribution of a species. An article by Nuttonson attempts to relate phenological observations to photoperiodic phenomena. That a wealth of information on plant behaviour in relation to climatic factors lies untapped in phenological observations the world over is certainly true, but Nuttonson's paper does not appreciably advance this study, nor will it be advanced until the full resources of modern statistical technique are applied to it. The remaining papers need not be considered individually, though some of them are quite useful reviews, albeit with considerable overlaps and repetitions.

This critical review need not be taken as indicating that the book is not of value; on the contrary, every botanical and agricultural library should possess it, for it forms a valuable supplement to Whyte's *Crop Production and Environment*. As an example of book production it comes up to the high *Chronica Botanica* standard, except for its card covers, and it is provided with adequate author- and subject-indexes. The proof-reading has been

unexceptionable (Roberts and Struckmeyer's 'after-affect', however unfortunate, is repeated too often to be an error). A good many of the illustrations are of historical rather than scientific value (some are of neither), and the purchaser may well wonder whether the twelve plates really are worth the increase in cost they presumably entailed.

D. W. Goodall.

Chemistry

Advances in Catalysis and related subjects. Volume I. By W. G. Frankenburg, V. I. Komarewsky and E. K. Rideal. (New York: Academic Press, 1948. 321 pp., many text-figs. and tables. 6″ × 9″.) Price, $7.80.

Notable advances have been made in catalysts in recent years, especially that associated with heterogeneous processes. It used to be an accepted fact that a catalyst merely hastened the speed of a reaction, which would go by itself at a much reduced rate. At the end of the reaction the catalyst would be unchanged, at least as far as its chemical properties were concerned. A heterogeneous catalyst, however, may be destroyed by poisons; it may need activation by the addition of promotors, not all of which may be removed unchanged by the end of the reaction. The outstanding problems in heterogeneous catalysis have been: (*a*) nature and size of the catalyst surface, (*b*) nature of the physical and chemical processes taking place there, (*c*) energy changes involved, e.g., activation energy required, (*d*) specificity of catalyst for certain processes, (*e*) nature of poisoning, (*f*) significance of promotors. Many of these aspects are discussed in the book. There is a great mass of material presented, and references to original papers are abundant. The reader must not suppose that broad generalizations can be drawn with any facility. The distinction between van der Waals adsorption and chemisorption, however, is now well recognized, as also the transition from monolayers to adsorbed films two or more molecules thick.

A lot of the research work discussed has had a great bearing on the activities of World War II; notably the alkylation of iso-paraffins discussed by Ipatieff and Schmerling, which was important for the synthesis of high octane-number motor fuel for aviation.

The Fischer-Tropsch synthesis is also discussed in papers by Griffith and Storch, this process being extremely important for the production of hydrocarbon oils. Much of the theory of what happens at the catalyst surface is speculative, but highly instructive in providing an insight into how ideas of surface structure and molecular geometry may be applied to practical problems.

The book has a full complement of tables and figures, but not many diagrams of actual experimental set-ups. There are, however, some excellent photographs of Debye-Scherrer scattering from alumina gel, which illustrate the effect of heating this useful but sometimes capricious catalyst.

The book will be useful to advanced students and research workers in applied chemistry. There is more to come.

T. Iredale.

S.A.A. Volumetric Glassware Code. Published by Standards Association of Australia. (Science House, 157 Gloucester Street, Sydney, 1949. 35 pp., paper covers.) Price, 5*s*.

One of the minor consequences of the recent war was the fact that, owing to the loss of overseas supplies, it became necessary to manufacture volumetric glassware in Australia. The first step in this process was the drawing up of specifications, a task which was carried out by the Standards Association of Australia. As is well known, the successful manufacture of volumetric glassware was achieved. 'It is now felt desirable to publish a code of recommended specifications, in order that apparatus complying with these specifications will be used in the manner for which it was calibrated.' That is of course a basic requirement for any accurate work in volumetric analysis. The *Code* describes procedures for the correct calibration and use of volumetric glassware; these are all clearly stated and suitably illustrated.

The reviewer has only one minor criticism to offer: a litle more space might have been given to a fuller discussion of drainage errors in volumetric glassware, using some of the illuminating data published by Stott. The procedures are given fully enough, but more might have been done to give reasons for the procedures.

The booklet will be most useful to those interested in volumetric analysis and certainly should be in the hands of all serious students of chemistry. Though the published price is high for a book of this size, it may interest intending purchasers to know that a substantial reduction in price is made for students and educational bodies.

D. P. Mellor.

Forestry

Logging. The Principles and Methods of Harvesting Timber in the United States and Canada. By Nelson C. Brown. (New York: John Wiley and Sons; London: Chapman and Hall, 1949. 418 pp., text-figures and photographs, 44 tables. 9″ × 6″.) Price, $5.00.

This book fills a long-felt need in the timber industry and will be of value to all progressive loggers and students of forestry generally. It is a revision of two earlier books by the same author and has been brought up to date so that it covers all logging equipment from horses to 'skyhooks'.

The author says 'It may be poor or indifferent forestry, but logging is the important part of forestry, in which our woods are treated and a future supply of timber is assured, or the areas are left in an unproductive condition'. He points out that, as a result of the high cost and relative inefficiency of forest labour, mechanical devices have been developed to replace manual labour in all forest regions. In every section of the country, methods must be employed to suit the local conditions of topography, climate, density of timber, volume flow of logs, and size of individual trees.

The author particularly explains the mechanical devices that have been developed in connection with the following changing methods of logging:

(*a*) Expanded use of tractors;

(*b*) Felling and bucking with chain saws;

(*c*) Use of motor trucks as a major method of log transportation;

(*d*) Skidding logs in tree lengths;

(*e*) The great variety of loading devices required for loading and unloading, particularly pulpwood and the small timber encountered in prelogging and relogging operations.

The clear descriptions of equipment and methods will be of great value in the formulating of logging plans for either hardwood or exotic conifer forests. They will be appreciated by all connected with the logging industry in Australia and New Zealand.

R. H. NEEDHAM.

Geology

MINERALS AND HOW TO STUDY THEM. By the late E. S. Dana. Third Edition, revised by C. S. Hurlbut, Jr. (New York: John Wiley & Sons; London: Chapman and Hall, 1949. Frontispiece in colour, 323 pp., 387 text-figs. $5\frac{1}{2}'' \times 8\frac{1}{4}''$.) Price, $3.90.

Most people are interested in the beautiful shapes and colours of minerals, and the making of a mineral collection is a fascinating and instructive hobby. Dana's *Minerals and How to Study Them* was first published in 1895 to popularize the study of mineralogy. It was one of the first books of the kind to present facts about minerals in a simple manner for the beginner or amateur; for it is to the latter rather than to the serious student of mineralogy that it is addressed. The Third Edition is an attractive volume entirely revised and rewritten by Professor Cornelius S. Hurlbut, Jr., of Harvard University.

Shape being probably one of the first things that is noticed about a mineral, the chapter on Crystals and Crystal Habits gives the fundamental principles of crystallography. This chapter will find its greatest use when studied with the help of models of crystals, which are not generally, in this country, readily available to amateurs (though the intelligent examination of museum specimens, even through the showcase glass, would certainly help). Other chapter headings indicate the scope of the book: Physical Properties of Minerals; Chemical Properties of Minerals; Use of the Blowpipe; Description of Mineral Species; On the Determination of Minerals. This last chapter contains numerous practical hints on how to identify minerals. With the help of the Determinative Tables, plus a little practice and familiarity, it should be possible to identify any of the common minerals. There are two Appendices, the first giving a List of Common Minerals arranged according to Prominent Elements; and the second, the Most Important Minerals for a Small Collection.

The book is well printed on art paper, which gives excellent reproductions of photographs of mineral specimens; perhaps the best being Figure 303, Gypsum Crystals. The frontispiece consists of two colour-reproductions of museum specimens of minerals which anyone, mineralogist or not, would like to possess.

This book can be recommended to amateur mineralogists, to students up to the Leaving Certificate standard, and to scientists and non-scientists requiring a small but comprehensive knowledge of the subject; all would find therein a wealth of information written in a most readable and easily understood manner.

DOROTHY CARROLL.

Physics

SCIENTIFIC FOUNDATIONS OF VACUUM TECHNIQUE. By Saul Dushman. (New York: John Wiley and Sons; London: Chapman and Hall, 1949. 882 pp., many text-figs. $6'' \times 9''$.) Price, $15.00.

In 1922 Dushman published a small volume entitled, *The Production and Measurement of High Vacua*. Since then, vacuum technique has become increasingly important, both in purely scientific investigations and in industry. Improvements have been made in the methods of production and measurement of low pressures. Much knowledge has been acquired regarding the sorption, solution, etc., of gases and vapours, and means have been developed to produce extremely high vacuum in sealed-off devices.

In the *Scientific Foundations of Vacuum Technique*, published this year, Dushman has attempted to present an up-to-date and critical survey useful to both scientists and engineers. That attempt appears to be highly successful and this substantial volume will probably be regarded as a standard work on the subject for some years to come. It is well written and attractively published, and is rich in references, tables of data, graphs and diagrams of apparatus.

The author has divided the work into twelve chapters and follows the general layout of his earlier treatise. The first two chapters are concerned with the kinetic theory of gases and the flow of gases through tubes and orifices. In the following four parts there is a wealth

of information on mechanical pumps, on vapour pumps using mercury and organic liquids, and on manometers for measuring low pressures. The sorption of gases and vapours by solids is treated theoretically, and in its practical aspects in the case of such materials as charcoal, silicates and cellulose. A section, extending over a hundred pages, deals with the subject of gases and metals. This is followed by a survey of chemical and electrical methods of clean-up of gases at low pressures. Chapter 11 deals with vapour pressures and rates of evaporation; in the concluding section, the dissociation pressures of oxides, hydrides and nitrides and rates of oxidation are discussed.

J. BANNON.

Psychology

PSYCHOLOGICAL STATISTICS. By Quinn McNemar. (New York: John Wiley; London: Chapman and Hall, 1949. 364 pp., 70 tables. $5\frac{1}{2}'' \times 8\frac{1}{4}''$.) Price, $4.40.

This book follows the newer view that introductory statistical texts for students of psychology should make the approach through sampling and statistical inference rather than restrict themselves primarily to descriptive statistics. McNemar has been a leading contributor to psychometrics through his rigorous statistical studies, as well as a leading teacher in the field. Consequently, as one might expect, this book is sound, lucid and practical.

Beginning with tabular and graphic methods and the elements of descriptive statistics, McNemar proceeds in his third chapter to a clear account of probability and then to the elements of sampling and statistical inference. The following five chapters deal with bivariate and multivariate correlations, one being devoted to a very necessary discussion of the factors affecting the correlation coefficient. The final six chapters return to sampling and inference, covering Chi-square and its major applications, Student's t in its various applications, and the analysis of variance. The major omissions from the table of contents are the psychophysical methods and factorial analysis. The psychophysical methods are basic for scaling, and consequently have a contribution to make to the refinement of quantification in psychology. Factorial analysis, which can in at least one of its forms be succinctly expounded, has been perhaps the most illuminating statistical device in mental testing. Consequently one regrets that writers of statistical texts follow the convention not to include these topics; one had hoped that Guilford had broken down this convention. Nevertheless it must be conceded that McNemar has by his treatment of other topics made the student's task of going on to these two a fairly easy one.

While it cannot be expected that all users of statistical method be competent in the underlying mathematics, one can ask that they do not proceed by blindly following what to them are arbitrary rules. Otherwise statistical method is almost certain to be misapplied in any but the most regular situations. McNemar makes a worthy and successful effort to bring real understanding to all those non-mathematicians who do not suffer the all too common malady that is brought on by the sight of equations or symbolization. Throughout he tries to make procedures intelligible by verbal discussion of the underlying assumptions, and by simple algebraic demonstrations where such are possible, or by empirical demonstrations. Further, he encourages the student to do a little simple mathematical foraging for himself. The actual computational steps involved in the use of the various procedures are made clear by worked examples.

This book, with its modern emphasis, its clear exposition, and its explication of the assumptions and limitations of each technique, will be a valuable aid to those who teach statistical method to students of psychology and related subjects.

W. M. O'NEIL.

Radiophysics

RADIO WAVE PROPAGATION. Report of Committee on Propagation, U.S. National Defence Research Committee. Edited by S. S. Attwood. (New York: Academic Press, 1949. 548 pp., numerous text-figs. and tables. $7\frac{3}{4}'' \times 10\frac{1}{4}''$.) Price, $8.80.

This book contains an extensive record of wartime work on the propagation of radio waves through the troposphere, both in the United States and in British countries.

World War II was a scientific war, not only because of the number of new weapons employed, but also on account of the unprecedented attention given to the manner in which these new weapons (and the old ones too) should be used for greatest efficiency. Out of such 'operational research' much new scientific knowledge of a general character was obtained. Tropospheric propagation advanced rapidly in this way.

Before the war ultra-short radio waves were just beginning to be exploited and knowledge of their propagation characteristics was quite limited. The introduction of radar stations in Great Britain for air warning purposes led immediately to studies of the performance capabilities of such stations, and of the criteria determining the choice of sites. It was soon found that propagation conditions sometimes became 'anomalous', especially at the shortest wavelengths, and an association with certain meteorological conditions was recognized. These large variations in radar performance had great tactical significance, and accordingly received detailed study, both from the theoretical side and by means of a number of specially-conducted experiments. The main advances came in Britain and America, but important work was done also in Australia,

New Zealand and Canada. The Australian work mainly covered the effects associated with the meteorology of the region. By the end of the war the main features of tropospheric propagation, under standard and non-standard conditions, were well understood. This knowledge is now being applied to the many peacetime applications of ultra-short and microwaves.

The material in the book under review was first published in a limited edition of three separate volumes as the Summary Technical Report of the Committee on Propagation of the U.S. National Defence Research Committee. Following declassification, the three separate volumes are now published under one cover for general sale, with only minor changes. Thus the material has been consolidated twice: first from the work of many groups down to three volumes and then to a single volume. This has led to a certain lack of coherence in the general layout of the book, some of the information being presented twice, and several chapters appearing as rather disjointed fragments. Despite this, the book should be of great value to the engineer wishing to use ultra-short waves, and to the physicist interested in the troposphere. It contains by far the most comprehensive treatment of its subject yet available.

The first volume gives a general summary of the theoretical and experimental work, followed by a miscellaneous collection of reports on various topics presented to wartime conferences. One of these, entitled 'Siting and Coverage of Ground Radars', is possibly the best chapter of the whole book, presenting a notably clear and comprehensive account. The main review of radio meteorology also appears here.

The results of radio wave propagation experiments of various types are set out in Volume II. These include studies off the main line, such as atmospheric absorption and scattering, storm detection, ground reflection, and the properties of echoes and targets.

Volume III is a self-contained unit, repeating much of the earlier material, having been written towards the end of the war as a handbook on 'The Propagation of Radio Waves through the Standard Atmosphere'. This portion of the book could well be used as a textbook for students in specialist courses.

The book is rounded off by two long bibliographies, containing several hundred references to published papers and wartime reports.

F. J. KERR.

Zoology

BIRDS IN BRITAIN. By Frances Pitt. (London: MacMillan & Co., 1948. 16 plates in colour, over 300 photographs and line drawings. 9″ × 6″.) English price, £1 1s.

In Britain, as in Australia of recent years, there has been a spate of books in natural history appealing for the custom of the layman primarily by retailing pleasant anecdote with a minimum of ordered instruction. Miss Frances Pitt, the well-known English natural history writer, has in this work given us a popular book of a more satisfying type. 'There seemed space', she explains in her preface, 'for . . . a survey of the bird life, wild, feral and domestic, in Britain, which would tell concisely of their status, appearance and habits, with the special view of assisting the recruit to the study of ornithology. But it was not so much the feeling that such a book was wanted that induced the author to undertake the task as that desire to write about birds which assails those who feel their deep fascination—I wanted to write a book on *Birds in Britain* and so this volume came into being'.

The result is an attractive compendium on British birds which can be used as a source book on the subject by the general reader for most of the information he is likely to want to know about it. It is sufficiently systematic in scope and treatment to satisfy the more scientifically-minded layman, and yet popular enough in style and provided lavishly with illustrations, so that no one with an interest in birds could feel repelled.

The book opens with a general survey of the class of birds, their classification, structure, distribution, migration and behaviour. The bulk, however, is a general review of British species, family by family, starting with the crows and ending with the pheasants, partridges and quails. Each individual species is treated, and the accounts of them include a description of their appearance, their nesting habits, and general points of interest in their behaviour and ecology. The information is comprehensive and up to date, the results of modern research having been incorporated. The Australian News and Information Bureau, which provided the authoress with her illustration of the Lyre Bird, let her down, however, with an obsolete picture of a mounted specimen showing the tail in a pose never seen in nature.

As throughout the centuries birds have inspired some of the finest poetry in the language, it is pleasing to note the copious extracts from English poets, from the thirteenth century onward, adroitly woven into the text.

The book is a unit in the 'In Britain' series, edited by L. J. F. Brimble, joint editor of *Nature*.

D. L. SERVENTY.

Book Notices

DIRECTORY OF THE RESEARCH ORGANIZATIONS IN THE UNION OF SOUTH AFRICA. Compiled by the Liaison Division of the South African C.S.I.R. (Pretoria, 1948. 45 pp., 16 charts, duplicated, foolscap.)

The Directory gives the scheme of research organization and analysis of functions in the C.S.I.R. and the Departments of Agriculture, Commerce and Industry (Fisheries), Forestry, Mines and Transport (Meteorology). There follow short accounts of industrial research organizations sub-

sidized by the Government: The Deep Level Mining Research Institute, Fishery Industry Research Institute, Fuel Research Institute, Leather Industries Research Institute, Paint Industries Research Institute, South African Institute for Medical Research, Sugar Milling Research Institute, Wattle Research Institute, Diamond Research Laboratory (Johannesburg), South African Sugar Association Experiment Station, Transvaal Chamber of Mines (Dust and Ventilation Research; Timber Research).

IDENTIFICATION OF SOFTWOODS. D.S.I.R., Forest Products Research, Bull. No. 22. (London: H.M.S.O., 1948. 56 pp., 2 tables, 5 text figs., 3 plates. 6" × 9½", paper covers.) English price, 1*s.* 3*d.* net.

The subject matter of this Bulletin was originally published in the *Journ. Linnean Soc.*, Botany, *52*, 343, 1941, under the title, 'The Identification of Coniferous Woods by their Microscopic Structure'. In order to overcome the difficulties associated with dichotomous keys, a multiple key has been developed, of the kind described by Clarke, *New Phytol.*, *37*, 387, 1938. The characters of each species are recorded on cards which have marginal series of perforations and are adapted for rapid mechanical sorting, by threading a needle through each set of holes in turn. Thirty-three characteristics have been selected for the diagnosis, grouped as General, 7; Tracheids, 5; Parenchyma, 3; Rays, 7; Cross Field Pits, 5; Resin Ducts, 6. Provision is made for adding Botanical Families, 7; Geographical Regions, 11. Notes are given on the selected diagnostic features, together with some other features of more limited value. The published key includes representatives of the twenty-three genera common in the timber trade in the United Kingdom, together with other genera producing sizeable trees, to a total of 114 species. The brief descriptive notes given in the text also cover remaining genera. There is a considerable list of references; also an index and check-list.

FACTORS IN BOTANICAL PUBLICATION and other Essays. By Neil E. Stevens. *Chronica Botanica, 11*, 3, 119-206. (Waltham, Mass.: Chronica Botanica Co., 1947. 88 pp. 6½" × 10", paper covers.) Price, $2.00.

A set of reprinted essays by the Professor of Plant Pathology in the University of Illinois, with a bibliography of papers published in the period 1910-1947. The seventeen selected titles include: The Botany of the New England Poets, The Fad as a Factor in Botanical Publications, Applied Botany as Fun, The Anecdote as an Antidote to Statistical Analysis, Objectives in Biological Courses, Botanical Figures in Biblical Prophecy, Radicalism and Research in America, The Obligation of the Investigator to the Library, Bureaucracy as a Way of Life, Botanical Research by Unfashionable Technics, Is Teaching Ability Recognized?, The Excessive Meekness of American Botanists, and Brevity at Botanical Banquets. In the last-mentioned essay, Stevens points out that many of the great speeches of history were less than 300 words in length; he refers the after-dinner speaker to the book of *Ecclesiasticus, 31*, 8.

CLIMATE AND HOUSE DESIGN: PHYSIOLOGICAL CONSIDERATIONS. By J. W. Drysdale. Commonwealth Experimental Building Station, Duplicated Document No. 25. (Sydney: Dept. of Works and Housing, 1948. 15 pp., tables. Duplicated typescript, foolscap, manila covers.) Price, 1*s.*

The Station's preliminary investigations on climate and house design, for the period 1945-1947, were published previously, in Document No. 21. They dealt with field studies of the thermal characteristics of different forms of construction. The next step was to relate temperature to comfort. The physiologist's view, that pulse rate, rectal temperature and other clinical indications indicate the strain on the human body when subjected to environmental stress, was not considered satisfactory as an indicator of comfort, especially for the relation of comfort increment to increase in building cost. The standard reference scale for the comparison of atmospheric environments has been the Effective Temperature Chart of the American Society of Heating and Ventilating Engineers. This was found to be inapplicable to house design under Australian conditions at elevated temperatures, especially with regard to the importance of moderate rates of air movement.

Experiments showed that the significant criterion is the point at which body perspiration appears, and that this is best detected by dampness at the waist and thighs, causing the clothes to cling. Briefly, the test results showed that the discomfort stage is reached by 15 per cent. and 50 per cent. of appropriately clothed subjects, respectively, at the following dry-bulb temperatures: Broken Hill, 85°, 86° F.; Sydney, 82°, 84½° F.; Townsville, 81°, 86° F. The latter figures correspond respectively to 75°, 78° and 80° Effective Temperature, on the A.S.H.V.E. scale. No observable difference was found between the reactions of males and females.

Subject to further tests, it appears that houses should be designed to keep temperatures below 84° or 85° F. for the greatest possible period on hot days, with an air movement above 30 to 50 feet per minute.

SUNSHINE AND SHADE IN AUSTRALIA. By R. O. Phillips. Commonwealth Experimental Building Station, Duplicated Document No. 23. (Sydney: Dept. of Works and Housing, 1948. 20 pp., 22 plates. Duplicated typescript, foolscap, manila covers.) Price, 1*s.*

Elementary principles, directions, and charts for the solution of problems of the penetration of windows by sunlight and the shading of walls, at any aspect, in the latitudes of Australia, New Zealand, New Guinea and adjacent Islands. A celluloid Shadow-Angle Protractor accompanies the Document.

THERMAL CHARACTERISTICS OF MODEL STRUCTURES. Commonwealth Experimental Building Station, Duplicated Document No. 26. (Sydney: Dept. of Works and Housing, 1948. 20 pp., 3 plates, tables. Duplicated typescript, foolscap, manila covers.) Price, 1*s.*

The Station's preliminary investigations on climate and house design, for the period 1945-1947, published as Document No. 21, indicated that the thermal performances of some structures could be predicted from a study of the behaviour of small models of similar construction (e.g., at one-ninth scale), and that the relative thermal performances of different forms of construction bear a relatively constant relationship one to another during hot summer days, irrespective of geographical location. In scaling down a structure linearly, it is necessary to retain an appropriate mass-scale ratio in order to preserve thermal performance: isolated brass strips were sometimes added as an aid to this end. Areal relationships must also be maintained at points of contact of members, e.g., by chamfering.

The efficacy of model tests has been demonstrated, and conclusions have been drawn as to ceiling height, as to characteristics of materials and type-constructions for insulating materials in outer walls and inner partitions, and as to window ventilation. Further tests will proceed to wall shadowing, and to laboratory reproduction of field conditions. No tests are proposed for winter conditions.

INDUSTRIAL ELECTRICITY. Volume II—Alternating Currents. By William H. Timbie and Frank G. Willson. (New York: John Wiley; London: Chapman and Hall, 1949. 781 pp., numerous photos. and text figs. 5½" × 8½".) Price, $5.96.

An elementary text-book on electrical engineering. A balance is struck between physical theory and engineering practice, and neither is treated in great detail. The book contains many useful numerical examples.

The Australian Journal of Science

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All contributions should be forwarded to the Editors, Australian Journal of Science, c/o Australian National Research Council, Room 305, Science House, 157-161 Gloucester Street, Sydney, Australia.

The publication dates are the 21st of August, October, December, February, April and June. Contributions should be forwarded at least two months before the date of publication.

Contributors of articles, etc., will greatly assist the Editorial Committee by following these instructions.

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References to literature in the text should be made by placing the year of the publication in parentheses after the names of the authors, thus: 'Wilkerson (1934) has shown that . . .'. References should be arranged at the end of articles in the alphabetical order of the authors' names. Titles of articles referred to should not be given.

The following example indicates how references should be set out: Wilkerson, J. A. (1934): *J. biol. Chem.*, *104*, 541.

The abbreviations of names of periodicals should be those given in the *World List of Periodicals.*

References to books should give the full title, followed by the publisher's name and the city in which the publication was issued.

If author's reprints are required, the number should be stated when the paper is submitted. Reprints will be made available at COST PRICE.

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The Australian Journal of Science

VOL. 12 21 October 1949 No. 2

Research

I. M. MACKERRAS.*

An Address to Students in the University of Queensland

THE University is the chief centre of learning in a community. It has three essential duties: to collect and appraise the world's knowledge; to transmit it clearly and without bias to the students within its faculties, teaching them to think and understand as well as to know; and to extend the bounds of knowledge by active research. These are duties which it owes, not only to the community at large, but to the whole body of past workers who accumulated the knowledge it has inherited.

It is right, therefore, that every student should leave the University knowing something of the meaning of *research*. In pure Science this can be achieved; because senior students generally see research going on around them, while the honours year in most Universities is treated as an introduction to research. Others have not that advantage, and some substitute must be found. They are told only of the results of research; sometimes, how a particular investigation was carried out. This review is an attempt to crystallize such a series of impressions: it is a poor substitute for participation, because the real meaning of research can grow on one only gradually, with experience.

Perhaps the simplest way to approach the problem is to attempt to answer three questions: What is research? Why is research done? How is research done?

WHAT IS RESEARCH?

Diligent inquiry or examination in seeking facts or principles; laborious or continued search after truth. (*Webster's Twentieth Century Dictionary.*)

That is a fairly adequate definition; it sticks to principles. One likes 'diligent', 'continued', 'laborious', 'truth'; but it could be shortened, and research defined simply as *exploration.* You choose a path to the boundary of existing knowledge; you train yourself while you are on the path, as troops do with tactical exercises in peace-time; you provide yourself as you go with such equipment and helpers as your experience indicates and your means allow; you take a bearing through the unknown territory when you reach its edge; and off you go. You may have a fair idea of the direction you want to take, *but you don't know what you are going to find.*

That is one of the fascinating things about research. You may get lost, and you can be quite sure that you will meet difficulties—ravines, jungles, cul-de-sacs—but you do not know what clear eminence you may reach, nor what wide prospect it may open up. Even if you fail to climb any lofty peak, you can still map the country you traverse, so that those who follow will benefit by your experience; and that is useful work too. You may, perhaps, leave your name on some small creek or outcrop to show that you were there first!

That is research in the abstract. In practice, there are as many kinds as there are fields of knowledge and purposes to be fulfilled, but all fall into three main classes: observation, experiment, integration. They are not mutually exclusive and one frequently leads into another.

Observation

This is the oldest and simplest kind of research. It necessarily precedes experiment or inference, and it is basic to all research, except perhaps in mathematics or pure philosophy. It may start without plan, but inevitably develops one as it proceeds.

A simple example of observational research is provided by the activities of the amateur entomologist. He collects insects, sorts them,

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identifies them from descriptions or by comparison with museum collections, and then discovers that he has found some which have never been seen before. He has added to the sum of human knowledge; but he does so effectively only if he describes his findings clearly and recognizably, so that all may know what he has found. The discovery is but one step; recording it is equally important, if it is to be of any intellectual or practical use.

The research may stop there; and a great deal of work published today in biology, chemistry, medicine and many other fields is simply observational and descriptive; but the enterprising observer will go further. Our entomologist will have had to classify his material as it accumulated, and he may well find that existing classifications do not truly represent evolutionary relationships within his group; he may examine the distribution of his beasts, and be led to faunal and zoogeographical studies; or he may extend his simple collecting activities to include observation of life histories, behaviour and populations, and thus enter the broad field of ecology. Observation has led to integration and inference. *The Origin of Species* was written as an integration of an enormous number of previously unconnected observations.

The experimental approach has been so successful that simple observational research has become unfashionable. Nevertheless, it is still basic, still requires critical judgement, and it has two very material advantages. One is that it provides the beginner with the simplest and smoothest entry into a life of research. Its tools are usually few, its costs low, and the size of the task can be fitted relatively easily to the capacity of the worker and the time available; all important considerations to the research student. A second is that the enterprising worker in a routine laboratory has endless opportunities to make useful observations as he goes about his daily tasks, and it is not excessively difficult to watch for these opportunities, accumulate data as he goes along, analyse and integrate it, and thus add a little more to knowledge and understanding. Research then becomes a hobby.

Experiment

Experiment is no more than controlled and organized observation. You wish to observe what happens in a particular set of circumstances, so you set up an experiment. You may experiment, as you observe, simply to discover what happens, or to test an hypothesis. The experimental method has the advantages of greater scope for ingenuity, flexibility, reduction of variables, and controllability both in design and in means to test the reliability of its results. It has, as said above, been highly successful, so successful that it has largely replaced ordinary observation in physics, chemistry and physiology; and it is being used more and more in pure biology, as fresh means are found to induce living creatures and their component cells to behave naturally under artificial conditions.

Mendel obtained his results from experiment, but we may choose a more modern example from malaria research to illustrate the experimental approach to a problem. It was known that the large phagocytic cells in the spleen and elsewhere devoured malaria parasites; it was known, too, that their activity increased greatly at a particular stage in the infection; and it was suspected that humoral antibodies activated the macrophages. An experiment was set up to test the point (Zuckerman). Macrophages were grown in tissue culture; washed parasitized red cells were added to them, and then serum. If the serum were from a normal animal, there was some phagocytosis, but not a great deal. (This is the normal control, which can always be arranged in an experiment but is often difficult to provide in a field observation.) If the serum were from an immune animal, phagocytosis was greatly increased, corresponding to what had been seen in natural infections. That the serum and not the quality of the macrophages was responsible for the results was shown by a reciprocal series of tests:

Serum from normal, macrophages from normal, phagocytosis +.
Serum from immune, macrophages from normal, phagocytosis + + +.
Serum from normal, macrophages from immune, phagocytosis +.
Serum from immune, macrophages from immune, phagocytosis + + +.

The result supported the hypothesis, but there was one observation which was not in the plan. It was found that, not only were parasitized red cells 'sensitized' by immune serum, but normal red cells too; and so a way was opened to study erythrophagocytosis, which is a common and puzzling phenomenon in malaria

and certain other blood infections. It is a very frequent feature of experimental research that 'one thing leads to another'.

Integration and Inference

The final step in any piece of research, other than simple recorded observation, is to attempt to relate one's findings to some general principle of nature. Anyone of reasonable intelligence can observe, record, and test or extend a principle that has already been propounded; it is the mark of genius (or, occasionally, of great good luck) to set up a new principle or found a new method. On a smaller scale, a touch of genius is needed, too, to dispose of some long held, erroneous belief.

To take the last first, when Manson found developing filarial larvae in his mosquitoes, everyone 'knew' that mosquitoes fed on blood only once, laid their eggs on water, and died; so he had to hypothecate infection through drinking water to complete the chain. It is the special merit in the work of Ronald Ross and T. L. Bancroft, working independently, that they tested tradition, and demonstrated that mosquitoes would feed repeatedly on blood and would live quite long enough to serve, themselves, as transmitting agents. Elucidation of the full life-cycle of the parasites was then a relatively simple matter.

In the larger field, we have already mentioned Darwin and Mendel. Another striking example may be reduced to a few brief sentences, which again illustrates the principle that 'one thing leads to another'. We all know the sudden change in pitch that occurs in the whistle of a railway train or the roar of an aeroplane engine as it passes us. Doppler observed it long before there were aeroplanes, and established the principle which bears his name. Later, its generality was proved, and it was found to apply to light as well as sound. Later still, it was applied to the 'shift to the red' observed in nebular spectra, and thus led directly to the great principle of the expanding universe.

This is an example of both inductive and deductive reasoning. *Induction* is defined as 'the method of reasoning from particular or individual cases to general conclusions'. Doppler arrived at his principle by induction, so did Darwin and Mendel, and so do most workers who seek to find some general significance in a mass of biological material. *Deduction* is 'the method by which particular consequences or applications are deduced from general principles'. The expanding universe was deduced from Doppler's principle; many experiments are planned with an 'expected result' deduced from the hypothesis they are designed to test; deductive reasoning is employed very largely in applied research. These two methods of reasoning are often used quite informally and almost unconsciously, but together they represent the disciplined analytical and integrative thought that lies behind all constructive resarch.

Pure and Applied Research

Another widely used subdivision of research is into 'pure' and 'applied'. *Pure research* is usually regarded as research undertaken for its own sake, for the pure joy of exploration, without any ulterior motive. It has, paradoxically, been responsible, directly or indirectly, for almost every important discovery that has benefited mankind. The Universities have long been the homes of pure research, and it is well that they should remain so; for, if they do not, applied research will languish and fall into premature senility.

Applied research is research directed to the material benefit, or the destruction, of mankind. Sometimes, as in war, it becomes an urgent necessity for survival and victory. Insofar as its motives are mercenary, it is a poor thing; but when it is based on ideals of service, and when it is pursued with the spirit of exploration and critical judgement, then it can take its place with pure research, and the differences between the two largely disappear. Nevertheless, by its nature it must remain, in the strict sense, the junior partner.

An often used variant is to speak of *fundamental*, as opposed to applied, research; meaning research into principles and basic phenomena underlying practical problems, rather than directly into their control. This is a distinction which quickly breaks down, as anyone knows who has found himself involved in the ecology of sheep blowflies or the behaviour of malaria parasites in the mosquito. Economic research organizations and medical research institutes all find that they must undertake a great deal of fundamental

research, if they are to make any progress in solving their problems of application. That is why they are so dependent on the universities to provide them with people who have been trained in pure research.

It is clear that the distinction between pure and applied research is not simple and obvious, but a subtle one, depending more on point of view than on any fundamental difference in the nature of the problems or the way they should be attacked.

Why is Research done?

We have already introduced some of the purposes of research and the motives of those who engage in it, but this question is worth a little closer attention. Whatever the type of work, the prime motive that induces people to take up research is *curiosity*. The motto of Rikki Tikki's family, 'Run and find out', is the motto of the research worker; the Elephant's Child is his blood brother. Added to his curiosity, probably forming part of it, is something of the spirit of the fisherman, who doesn't know (or care very much) whether he will have a good day or a bad, but uses all his cunning to try to hook and land a succulent ten-pounder. Most of all, research is fun. There is something intensely exhilarating about finding a completely new creature, devising a neat experiment, or drawing a conclusion which no one had thought of before. This, I suspect, forms the common ground with the explorer, which justifies the analogy of exploration used in the previous section, and which determined the choice of Columbus as an example of a research worker, in a recent Bancroft Oration (Derrick, 1948).

There are other motives, some of them powerful, but in a sense secondary. A passion for truth is one, to which some give pride of place (Derrick, 1948); a sense of our debt to the workers of the past is another; an urge to benefit mankind, a third; and a hope for fame and immortality, a fourth. There are less noble motives too: an urge for gain or advantage, or to destroy one's enemies (unless one is driven to it by intolerable aggression); it has even been claimed that some people have taken up research simply to earn a living! One could enlarge indefinitely, because contributing factors are as varied as people's natures, but there is no profit in detail. This we know: however powerful these motives may be, if you lack curiosity, shun research; and if it is not the pleasantest and most exciting thing in the world to do, hesitate before you undertake it; for it is an arduous life, and its compensations lie within itself.

How is Research done?

Finding one's metier

The first step is the most difficult, and a heavy responsibility lies on Universities to provide opportunities for potential research workers. Few reach a pass degree knowing exactly what they want to do in the future. Most bright students know by then that one major field of learning interests them more than anything else, but that is as far as their inclinations and capacities have been crystallized. They need the chance to try their hand at a piece of work (or several, one after the other) so that they can find their 'line of country'. They cannot be expected to produce 'results' at this stage, merely to demonstrate their capacity to tackle a problem. The Commonwealth, and at least some of the States, provide fairly substantial sums, which can be used to test potential recruits to the scientific manpower of the country; and there are a few private benefactions which serve the same end. These are definite steps in the right direction, although we are poor as compared with Great Britain and the United States.

Choosing the Problem

Having found a field and seized an opportunity to explore it, the next step is to select a problem. Many factors will influence the initial choice, chance being by no means the least, but in any case the range of possibilities should be limited by quite severely practical considerations. Do not choose a difficult problem, at which experienced investigators have failed, however fascinating it may be; begin with something simple. Do not choose a large problem, which will take years to work out, but a little one, so circumscribed in itself that you will assuredly be able to make a job of it in the short time available to you. In this connexion, it is well to remember that a great deal of time is spent, even by experienced people, in pottering about with a problem. I do not know why this is so, but only a few brilliant workers seem able to avoid it, and it is highly

probable that you will suddenly realize that months have gone by before finding yourself on the straight, clear path which leads to the end of the work. Finally, choose a problem which can be tackled with relatively simple tools that you know how to use. There is genius in simplicity, and much merit can be shown in making a task simple and tackling it in the most direct way. If you heed these warnings, you will find that your entry into research is made easier and the risks of falling by the wayside are considerably reduced.

The word 'choose' is used advisedly, because the duty of the experienced worker is, not to set the research student a problem, but to help him to select one.

First Steps

The first step in the actual work is to read all you can about it and around it. Start with the abstracting and cataloguing journals, say for the past ten years. They should lead you to some papers on your subject, and these will lead you to others. If you are lucky, you may find that someone has written a bibliographical review. Card and abstract what you read. Later, you may need to return to the cataloguing journals to check them back to their beginnings, but this should not be overdone in the earlier stages, lest you find that it is swallowing up all your time and that you are losing the wood for the trees.

While you are doing this, you can also be having a preliminary look at your problem, collecting material, observing and noting, preparing and testing techniques. Then, on the foundation of reading and preliminary experience, you build your plan of work. It may be designed either to observe and record, or to test an hypothesis, and its nature will vary enormously with the kind of investigation; but it should be simple, clear, direct, and above all flexible. You will start with one plan, and it is highly probable that you will end with a different one. It has served its purpose if it has set you off well on your way through the unknown country.

Essentials of Planning

Any plan, however, must provide for a certain number of expected contingencies. It must provide for accuracy of observation or measurement, and means to test their accuracy; that the tools to be used are capable of doing the work required of them; that the validity of inferences can be tested; and finally, that results can be recorded clearly and accurately. Each of these is worth a paragraph.

Accuracy includes not only precision but freedom from bias. The 'near enough' is not 'good enough' in scientific work. And yet false precision is to be avoided, because it is both misleading and time-wasting. Nothing is more irritatingly futile than to see, say, a mortality in 43 rats recorded to two places of decimals! If measurements are used, they can be repeated, and an experimental error worked out; if observations are being recorded, their variability can be taken into account in assessing the accuracy of record that is really useful. Bias is more difficult to control, and requires critical watchfulness in everything that is done. An experiment is never set up to prove but to *test* an hypothesis. Repetition, whether of observation or experiment, is essential, and it is particularly useful if the same phenomenon can be examined by two or more procedures, each serving as a cross-check on the others.

'A bad worker blames his tools', but the truth is that a good worker has good tools, looks after them, and knows what they will do. Probably the most commonly used tool in biology is the microscope, and yet not one graduate or undergraduate in a hundred uses a microscope efficiently, or understands its adaptability and limitations. It is worth a great deal of time and trouble to learn to use the tools of research, and to fit the task to the tools or the tools to the task. There is more to be said on this subject later.

For the third point, some observations and experiments are complete in themselves; they are what is known as 'crucial', and admit of only one interpretation. Many, however, must be analysed and weighed, and the inferences from them drawn on the balance of evidence. The scientific worker is in exactly the same position as a judge in a court of law, applying a critical judgement to evidence, and using well-founded rules to test it. The conditions for test must, as already indicated, be provided for in the design of the work—repetition, variation in approach, provision of controls which will ensure a precise basis for com-

parison, and so on. The most useful single test, at least in biology, is statistical analysis. One would go so far as to say that no biological (including medical) worker is fully competent until he knows the meaning of variability and significance, can design his work so that his results will be amenable to statistical analysis, and knows when to use statistical tests or to call the trained statistician to his aid. Nevertheless, it is not to be inferred that statistical methods tell us anything about the meaning of our observations; they are most often purely a test of evidence, not of inferences, which must still be based on sound, logical reasoning.

Lastly, it has already been emphasized that carrying out the work is only half the task; it must still be described so that all may know and understand it. To this end, systematic recording and tabulation should be undertaken from the very beginning. The literature has already been carded and abstracted: results can be treated similarly. It saves a great deal of time if observations are not set aside to be worked up later, but can be dealt with and completed on the spot. One eminent Australian worker plans his experimental protocols and records so that, at the end, he has only to add an introduction and a conclusion, and there the paper is ready for publication. That is an ideal to be aimed at by every budding research worker, though doubtless it will be attainable by few.

These are not the only considerations, but they are probably the most salient. They have been given a good deal of space, because beginnings are the most difficult, and, naturally, of most immediate interest to a student audience. We may complete the story with some notes about research on a more complicated, though not necessarily a higher, plane.

The Development of Team-work

One complication comes from the increasing complexity of scientific knowledge. No man can now be competent in several branches of knowledge, and research problems often need to be tackled from several different points of view. The chemist, physicist and biologist are combining more and more, while the statistician is at everybody's beck and call. These associations are often quite loose, but the modern trend is to integrate them into organized teams, in which each member has a specific part to play.

This solves the problem of combining expertness in different fields of knowledge, but it brings further complications of its own. The individual cannot wander too far into interesting by-paths, lest he hold up the progress of the whole party. The plan of work must be prepared in considerable detail, so that everyone may know his place in it and what the others are doing. Leadership is clearly valuable to unify the efforts of the group, but may end in an hierarchial system, in which the subordinates are merely industrious mechanics. Flexibility and individuality, the two most important conditions for effective research, are both endangered.

These difficulties are real, and naturally they have provoked reactions, as witness the following quotation from a recent writer to the *Lancet* (1948):

> I wonder how our individualists are faring now that team-work is all the rage in modern research? I hope the research monomaniac is being catered for and that he will not be forced to toe the line in some dull mass project or other. How horrible to have one's chief popping into the lab and saying, 'We want a methyl group in this compound. Never mind why we want the methyl group; just give us the compound and we will give you fourth—no, third—place in the publication.
>
> It would be interesting to start an Institute of Individual Research. Chaos, of course, would be inevitable, but it would be a mad glorious fruitful chaos. There would be no control over the workers at all. Each would have his own lab. and his own assistant and be left to work as and how he pleased. Some would start at 6 a.m. when others would be finishing a stout night's work . . . One snag would be to persuade the staff to stop work. The unrestricted joy of the chase is heady wine; once on the scent your worker is disorientated for time, place and person, and oblivious to all entreaties to down tools and rest. Is all this a pipe dream? . . .

Fortunately, such worries need not seriously affect the beginner; he can still feel his way in the more straightforward kinds of individual task, or learn research as an apprentice member of a team. The former is probably the better, because it fosters individuality of outlook from the beginning.

The Importance of Tools

The second major complication is that this is an era of almost miraculous development in tools of research. The microscope has grown in a few years from an instrument focusing visual rays to one focusing electron beams; from effective magnifications less than 1,000, to more than 50,000. Specific spectral absorption of chemical compounds can be examined from the long infra-red to the extremely short ultra-violet in specimens only a few micra in size. Compounds can be labelled and followed in their metabolic wanderings and changes through the body. Machines for all sorts of purposes have been made infinitely more sensitive than the human eye or ear or hand.

The important point about these tools is that they have made it possible to do things which were previously impossible, and to test what previously could only be speculative. Chromosomes could be seen in living cells, but the details of their internal structure could only be demonstrated by fixation and staining. Were these details real or artifacts? Phase-contrast and ultra-violet microscopy have shown that they are real. The distribution of nucleotides in cells could be inferred from their staining reactions, but demonstrated by microspectrophotometry. No one could have known that some viruses are shaped like bricks, others are filamentous, and still others like little tadpoles, until they were photographed with the electron microscope. A research biochemist recently said repeatedly in a series of lectures, 'That problem can be tackled with labelled . . .' carbon, or whatever the appropriate element was in each case.

Most of these new developments are the result of recent physical research, and most of their present uses are in problems which are basically biochemical. As already indicated, few biologists can be expert physicsts and biochemists too, and so the new tools have added strongly to the pressure for teamwork.

Organization of Research

With these considerations in mind, we may glance briefly, in conclusion, at the various ways in which research is organized.

Even simple research requires some organization. The individual working in a University requires money, a place to work in, access to literature, material and equipment, help with the chores (once he knows how to do them himself!), and perhaps some clerical or technical assistance. Someone has to provide these things, but that should not be his concern—it certainly should not be allowed to distract his mind from what he is trying to do. Given these, he can forget the world and work away by himself, in complete happiness and to the entire satisfaction of our friend in the *Lancet*. He can be solitary, but it is most undesirable that he should. Usually there are two or three people in the same place working on different problems in the same field of knowledge, and they can get together at frequent intervals to sharpen their wits on each other. The communal lunches begun by the late Professor Lancelot Harrison are now nearly thirty years in the past, but they still live vividly in the memories of those who shared in them. All the problems in zoology were canvassed at those lunches, and sometimes, if the discussion were particularly heated, it would still be going on amidst the debris of the food when the cleaners came in to sweep out the 'lab.' for the morrow. This is the sort of organization that works extremely well in the Universities.

Then we sometimes find, again in the Universities, that a worker not only becomes an authority in his field, but attracts others to it also, so that the work emanating from that school becomes characteristic of it. The independent workers are being integrated, but it is a voluntary association, held together by common interest and the personal qualities of the leader. The post-graduate school of parasitology that grew around G. H. F. Nuttall in Cambridge is an example of such a 'school of thought', which was fed from all parts of the world and disseminated its influence as widely.

As an example of a somewhat more complex level of organization, we may take the malaria research unit at Cairns (Queensland) during the war. The main problems were set by the Director of Medicine, but the unit was commanded by an officer, who was responsible for developing them and co-ordinating the different parts of the work. There were three sections—clinical, pathology, entomolgy (including parasitology)—each controlled by an experienced worker, who was responsible for developing his or her own part of the field and for leading a

group of research and technical assistants. It was a system of teams within a team, which fitted Army organization quite well. With mutual understanding and common interest, they achieved a beautifully integrated piece of work.

This kind of organization has been used by some of the Divisions of the C.S.I.R.O., and it is a very effective one for comparatively small institutions, like the medical research institutes of Australia. It is wide open to the dangers which were mentioned earlier under teamwork; but they can be met, and it can maintain unity of purpose, with quite adequate flexibility and 'intellectual elbow-room' for section leaders and individual workers, provided that the leaders at the various levels never forget that they are but *'primus inter pares'*, that all the members combine to formulate the plans and to discuss variations as they arise, and that individuality of outlook becomes secondary to common interest in the task in hand. These are not theoretical ideals; they have already been the basis of much combined research in peace as well as war.

Institutions of this kind may also develop into schools of thought—as has the Hall Institute in Melbourne—attracting able and intensely interested people to work in them. Then the hierarchy can really be broken down, for all become equals in their attack on a related group of research problems.

When a field of work grows huge, as when it includes all the agricultural problems of a country, or when it becomes especially complex and centred on an enormously expensive piece of equipment, like a modern fission pile, then increasing complexity of organization and administration naturally follows. The hierarchical principle tends to become firmly established, regulations tend to replace personal relations, and all sorts of everyday activities tend to be governed by complicated administrative machinery. Flexibility and individuality are likely to become extremely difficult to maintain, and a worker may see someone wandering in a corridor, ask a friend 'Who is that?', and receive the answer: 'The Director!'.

These conditions seem to be an inevitable consequence of size, whether in private corporations, government administration, or even in research. They are rather favoured in this age of organization, and, at least in research, they present some very grave problems, for which no effective answers seem yet to have been found.

The last type of organization to be considered has been developed in such fields as astronomy, epidemiology and oceanography, and has even included tests of preservatives against white ants. A lot of people agree—at an international congress, or under the influence of a powerful organization like the Rockefeller Foundation, or perhaps persuaded by an individual who has an idea and convinces them that it is a good one—that a particular set of observations is worth making in many different places. They form a common plan, each laboratory in widely scattered parts of the world sets about carrying out its part precisely as laid down, and they pool their results by sending them all to an agreed co-ordinating centre. A great deal of valuable astronomical research in particular is being carried out in just this way.

Thus, not only are results of individual scientific work made available by free publication to all people who may use them, but scientists have found ways to sink international differences of outlook and opinion, and combine together to a common end. These activities are still going on in a great many countries, in spite of the uncertainties of this post-war period, and this is surely food for thought by those who are concerned with other fields of human endeavour.

Postscriptum

Since writing this lecture, I have read Cannon's book, *The Way of an Investigator*, and find that I have unconsciously repeated much that he has said. I have left it so, because confirmation from similar unknowing repetition is by no means unknown in scientific work.

I. M. M.

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The Photographic Emulsion Technique in Nuclear Research

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The technique involved in the use of special photographic plates for nuclear research is described. A summary of the fundamental processes involved is also given.

1. *Introduction*

THE nuclear photographic plate has proved a valuable tool in nuclear research.† In this article, details are given of the general experimental methods involved in the use of nuclear photographic emulsions, and in particular of those techniques in use by the experimental group at the H. H. Wills Physical Laboratory, University of Bristol, under the leadership of Professor Powell.

Nuclear photographic emulsions are special types of emulsion, which after exposure to ionizing nuclear particles and subsequent development give clearly defined 'tracks'. The backing for the emulsion is usually glass, and on the glass is coated a layer of emulsion which has a very high percentage of silver bromide crystals dispersed in gelatine. As the ionizing particles pass through the emulsion they produce in some crystals a 'latent image', which is rendered visible by later development. After reduction to silver in the developing process, the path of the ionizing particle shows as a row of silver grains or a 'track' in the emulsion, under a magnification of from x100 to x1500.

An important feature of this technique is the very high density of the special emulsion (3·64 g./cc. approximately)—giving 7×10^{22} atoms/cc. Thus an emulsion 50 microns thick is equivalent to 10 cm. of air, or the emulsion has a stopping power relative to air of approximately 2,000 (although this is reduced for particles of low energy). The plate therefore resembles a cloud chamber in recording nuclear events, but with a very high stopping power; hence it has the convenience of small size as well as being a permanent record of events. Particles can be detected, ranging in mass from heavy fission fragments to electrons.

2. *Fundamental Processes*‡

(a) *Ionization.* The ionization per unit length of path depends only on the charge and the velocity of the particle and is independent of its mass:

$$I \propto \frac{(Ze)^2}{v^2}$$

Therefore the amount of ionization produced by a particle is a useful method of identifying the particle concerned. Hence a proton of mass 1, charge 1, gives the same ionization as a deuteron of mass 2, charge 1, of the same velocity. As the particles are being retarded by the emulsion, it is not convenient to compare particles of the same velocity, but rather to compare the ionization produced by particles over equal residual ranges; that is, over equal distances in the emulsion from their rest points.

(b) *Range.* The range of a particle in the emulsion depends on the type of particle, the energy, and the emulsion. As emulsions vary appreciably, the range or length of path of a particle in the emulsion correspondingly varies, and it is convenient to use one particular type of particle, for example an alpha particle or a proton, as a standard. Extensive experiments with such standard particles of known energy can then give the relation between the range and energy of the particles in the particular emulsion. The ranges of other particles relative to the standard can then be determined from the relation:

$$R_x(E) = \left(\frac{Z_{Std}}{Z_x}\right)^2 \cdot \left(\frac{M_x}{M_{Std}}\right) \cdot R_{Std}\left(\frac{M_{Std}}{M_x} \cdot E\right),$$

where

$R_x(E)$ = required range/energy relation, i.e., range of particle x at energy E,

$R_{Std}\left(\frac{M_{Std}}{M_x} \cdot E\right)$ = range of standard particle at energy equal to $\left(\frac{M_{Std}}{M_x} \cdot E\right)$,

Z_{Std}, Z_x = atomic charge of standard and other particle respectively,

M_{Std}, M_x = mass of standard or other particle respectively.

The experimental range/energy curves for alpha particles and protons have been obtained for various emulsions and are being extended continuously for larger energy ranges as the data become available.

From these curves, it can be shown that for equal ranges, the energy of an alpha particle, mass 4, charge 2, equals four times that of a proton, mass 1, charge 1, and the energy of a deuteron, mass 2, charge 1, equals $\frac{32}{25}$ that of a proton. Therefore, for equal ranges, the velocity of an alpha particle equals that of a proton and the velocity of a deuteron equals $\frac{4}{5}$ that of a proton.

Hence, from these facts and since (as has been stated) the ionization is proportional to the square of the charge and inversely proportional to the square of the velocity, the ionization produced over equal residual ranges of an alpha particle, a proton and a deuteron, is in the proportion 4:1:1·56. Thus a knowledge of the number of silver grains in equal residual lengths of tracks of particles aids considerably in the identification of the particles. The number of grains per unit length is of course not constant over the whole length of the track, but increases rapidly as the particle

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† Refer for example to—1939: *Nature*, *144*, 115; 1940: *Nature*, *145*, 155; 1947a: *Nature*, *159*, 93; 1947b: *Nature*, *159*, 301; 1947c: *Proc. Phys. Soc.*, *59*, 883; 1949: *Phys. Rev.*, *75*, 2, 3.

‡ See Webb, 1948.

nears the end of its range. This may not be noticeable when the density of ionization is very high, as for heavy fission fragments, for which the track is a solid line.

From theoretical considerations, the range/energy relationship for a particle has been determined, as well as the grain density/range relationship (Blau, 1949).

(c) *Small-angle Scattering.* The track often deviates by small amounts from a straight line. This is caused by scattering between the particle and the constituents of the emulsion. These small deviations help in the further identification of the particle, for the amount of this small-angle scattering depends on the mass of the ionizing particle. For example, electrons are very subject to this scattering, the tracks produced being most irregular, while alpha particles are very little affected. Mesons are identifiable by the characteristic small-angle scattering exhibited over their long thin wavy track, particularly near the end of their range.

3. *Sensitivity*

The threshold sensitivity for nuclear photographic plates (Webb, 1948) can be expressed in terms of the lowest rate of energy loss per centimetre of emulsion for which the track of a particle will just become a recognizable line of grains. This value is about 0·013 Mev. per cm. Fast particles with a smaller value of energy loss than this will not produce a recognizable line of grains in the emulsion. The maximum energy of various particles which will be registered in different emulsions varies, and for Eastman NTB plates and Kodak NT2a plates the maximum energies equivalent to an energy loss of 0·013 Mev. per cm. are given in Table I.

TABLE I
Energy in Mev.

Particle	NTB Plates	NT2a Plates
Deuteron	100	200
Proton	50	100
Alpha	>400	>400
Meson (200 M_e) . .	5	10
Electron	—	0·022

In order to record faster particles, an increase in the sensitivity of the emulsion of five to six times is required, to cover the complete range of particles encountered. Due to the non-linear relationship between these two factors, however, even a slight increase in sensitivity would open new fields of research.

4. *Technique*

(a) *Types of Plate.* There are various types of nuclear photographic plate available, made at present by two commercial manufacturers in England and U.S.A. (Kodak and Ilford). In Table II are tabulated some Ilford plates and their respective uses.

TABLE II

	Plate Number	Description
Grain size decreasing ↓	B2	Most sensitive; good alpha tracks and 2–4 Mev. proton tracks.
	C2	More-clearly defined alpha and proton tracks. Good proton and meson tracks.
	C3	Good meson tracks.
	E1	Better alpha tracks. Poor proton tracks.
	D1	Good fission tracks, poor alpha tracks, no proton tracks.

These plates can be obtained with the emulsion 50 or 100 microns thick; in addition, C2 and C3 plates can be obtained with the emulsion 200, 300 and 700 microns thick. All the emulsions can be loaded with lithium, boron or beryllium, for neutron reactions.

To secure an adequate record of protons of greater energy than 10 Mev., an emulsion at least 100 microns thick is required. To record higher energy particles, thicker emulsions are required. The processing of emulsions of thickness greater than 100 microns becomes progressively more difficult. This is caused by the shrinkage and distortion of the emulsion during processing; for the greater part of the solid matter in the emulsion is removed, namely the undeveloped silver halide. Also, a variation in development of the grains occurs with depth, those at the upper surface being more strongly developed than those near the glass. Thus confusion is caused in identification of particle tracks in the emulsion due to distortion of the tracks and to variations in grain development. A distorted proton track may appear to be the track of a meson suffering small-angle scattering, and variations in development may seem to be variations in ionization.

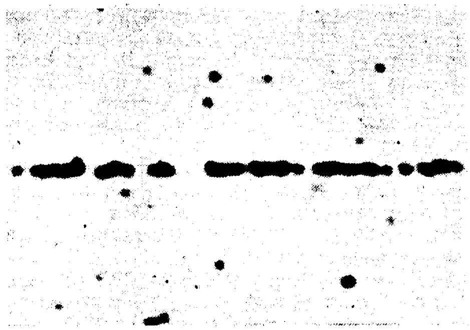
(b) *Processing.* The processing of the 50-micron and 100-micron plates is relatively simple. This follows techniques standard for all photographic work, but with variations to

TABLE III

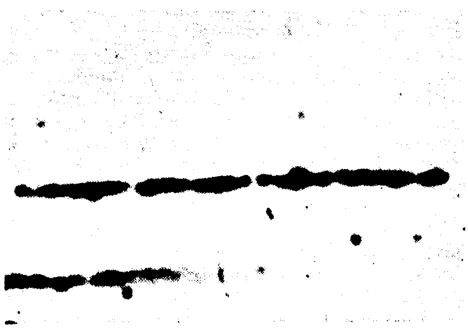
Type of Bath	Time in Minutes	
	50 µ Emulsion	100 µ Emulsion
1. Water at 18° to 20° C.	~10	~10
2. Developer: One part of an M.Q. developer (e.g., I.D. 19*b*) to three parts water, at 18° to 20° C. . .	28	35
3. Short stop: 1% to 2% acetic acid at 18° to 20° C. (or acid hardener)	~15	~15
4. Running water	~60	~60
5. Fixer: One part of hypo. saturated solution to two parts of water (see below)	$\frac{3}{2}$ × clearing-time	$\frac{3}{2}$ × clearing-time
6. Wash: Running water	~60	~60
7. Dry: At room temperature with the plate in a vertical plane . .	Overnight	Overnight

cope with the thickness and the density of the emulsion as well as shrinkage. In Table III the steps involved for the processing of these plates are outlined.

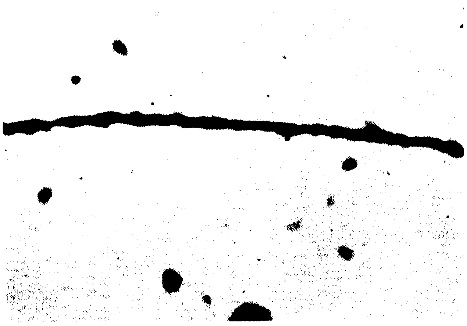
For uniform results, the fixing solution must be renewed after several intervals: for example,



(a)



(b)



(c)

Figure 1.
(a) Proton track.
(b) Alpha track.
(c) Uranium fission track.

4, 10, 20 minutes. For greater clarity and quicker clearing-time during fixation, ammonium thiosulphate, instead of hypo., has been used with some success. (A fixing solution of this type has recently been marketed commercially.) The addition of ammonium chloride to the hypo. has a similar effect, and has been found to reduce the fixing time by approximately one half (Franzinetti and Aitchison, unpublished). The quantity of ammonium chloride to be added to 30% hypo solution is 13% by weight of hypo used, and to 40% hypo solution is 2% by weight of hypo used.

Agitation is essential during development and fixation. At Bristol, this agitation is provided by a rocker consisting of a light-tight box with shelves to carry the developing dishes. These shelves are attached to a motor-driven cam and are gently rocked once per second to produce lamellar flow of the liquid over the plates.

For the thicker emulsions, the diffusion of developer and fixer through the emulsion is very slow, and therefore the time for the plates to remain in the developer has to be increased; this results in the upper surface of the emulsion being in contact with the developer for a longer time than is that part of the emulsion near the glass. As other grains, besides those forming the tracks of particles, become developed as the development time is increased, a background of fog is produced in the upper part of the emulsion. This makes detection of tracks difficult, and the emulsion appears dark brown in colour. Antifogging agents can be added to the developer, but are not very successful.

To overcome this difficulty, a temperature-development method has been evolved* which is a decided improvement for thick emulsions. The basis of this process is pre-saturation of the emulsion with developer at a low temperature where no development takes place, and subsequent development at 18° to 20°C. The procedure is as follows:

1. Soak plates for 38 minutes, at 8° to 9°C., in 1/1 developer (I.D. 19b): using, for example, packed ice. No agitation.
2. Add 2 parts of water, making developer 1/3. Over the next 6 to 10 minutes, increase the temperature from 9° to 19°C. Keep the temperature constant, between 19° and 19·5°C., for the next 24 to 28 minutes. No agitation to prevent surface fog.
3. Acid stop (2% acetic acid) for 30 minutes at 19°C. with constant agitation of the plates.
4. Fixing bath: 2 parts saturated hypo and 1 part of water at 17°C. with constant agitation.

The clearing time varies from several hours to 24 hours for these thick plates. The clearing time, and hence the bleaching effect caused by long fixing time, can be reduced by the addition of ammonium chloride as stated for the 100-μ plates.

This temperature-development method ensures uniform grain development throughout

* Method evolved by G. P. S. Occhialini.

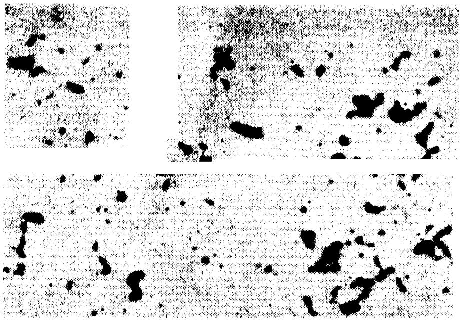


Figure 2
A single proton track with many electron tracks.

the emulsion, but the problems of complete fixation and of shrinkage are still present. Better methods of agitation give improved results. Various methods have been tried from time to time and one of the best seems to involve producing vortices very close to the emulsion surface during processing. This is possible, for example, by using a reciprocating vane sweeping very close to the surface of the emulsion in the fixing solution.

The use of pre-hardened films and a hot fixer (ammonium thiocyanate) may prove of value provided 3% of magnesium sulphate is added to the fixer to reduce surface reticulation (Burkin, 1947). (Prehardened emulsions are not yet available.)

(c) *Special Differential Development.* Instead of using different types of emulsions to differentiate between tracks of different ionizing particles, it is possible to under-develop; for example, to develop for only 10 minutes in I.D.19b and then 40 minutes in a special low-p_H developer (para-amino phenol). In this way no alpha particles are developed, only heavy-particle fission tracks. The use of chromic acid prior to development produces the same result. Proton tracks and alpha-particle tracks can be discriminated in a similar way, but with a considerable reduction in sensitivity.

5. *Calibration*

With regard to calibration of the plates, the range and small-angle scattering depend on the composition of the emulsion and should be similar in any one batch of emulsions. The grain spacing, however, depends on the sensitivity of individual grains, and this is very difficult to reproduce. Hence for accurate grain counts, control exposures to particles of known energy need to be made in the energy range to be used, and all plates require uniform handling during exposure and processing and must be stored at reduced temperatures (less than 8° C.).

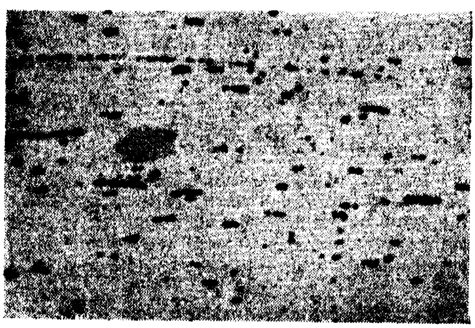
Where it is necessary to transport unexposed plates long distances, the preferred method is ship transport under refrigerated conditions ($\sim$0°C.). High tropical temperatures produce extensive background fog.

The Eastman (U.S.A.) Kodak NTA plates are tested by the manufacturer with alpha particles from Polonium (5·3 Mev.) and the NTB plates with protons from a cyclotron (7 Mev.); respective values are given with the plates.

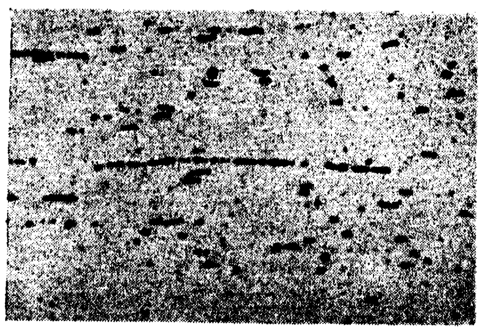
6. *Organization*

At Bristol (Powell and Occhialini, 1947), the plates, after processing, are labelled and examined, using microscopes with the best optical conditions; for accurate centring of the components is esential. The microscopes* have binocular eyepieces, a monocular objective, and a substage condensing system with a built-in illuminating system. A number of observers are employed for scanning the plates, the majority of which are cosmic ray plates, the remainder being general nuclear plates. The original scanning is done using x10 eyepieces and x20 objectives, and co-ordinates are recorded for each nuclear event found in the plate, using one corner of the plate as origin. Later, these events are examined under higher magnifications: x10 or x15 eyepieces and x45, x65 or x95 oil-immersion objectives. Coloured-ink dots are placed on the emulsion close to the event, the colour denoting the type of nuclear event present. If the processing has

* Cooke microscope, Catalogue No. M4000.

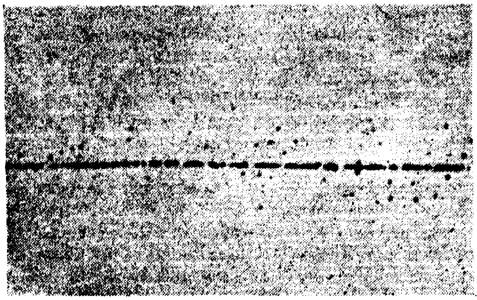


(a)

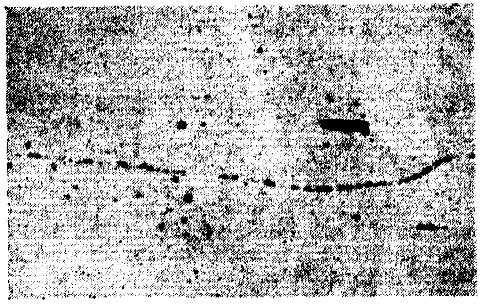


(b)

Figure 3
(a) Single proton track, with a few small deuteron tracks; (b) Deuteron track.



(a)



(b)

Figure 4.
(*a*) Proton track; (*b*) track of a meson at the end of its range.

been poor, then identification of tracks is difficult, because of the distortion of the emulsion or non-uniform development.

Any interesting or doubtful events are photographed with a Leica camera attached to the microscope, or with a special projection microscope; the latter has the advantage that the plate can be tilted to bring those tracks which dip into the emulsion into focus over a long length, in the one photograph. In the normal microscope, as the depth of focus is small, a succession of photographs is required as the focus has to be changed, and each photograph is taken overlapping the previous one. In this way a mosaic is formed, using identifiable grains in the tracks for alignment of the various pieces of the mosaic. These pieces are secured to a mounting board, using photographic mounting tissue and a hot iron, and the complete mosaic can then be re-photographed. The result is a projection of the three-dimensional tracks in the focal plane of the microscope. This projection is in error by a certain amount, as during processing the emulsion has shrunk by 40% to 50%; so that the angles of the tracks through the emulsion are altered considerably, and corrections have therefore to be made.

7. *Interpretation of Results*

Statistical methods play an important part in interpretation of all nuclear photographic-plate results, because none of the data, such as range/energy relations, grains per cm., and so on, are exact, and random statistical fluctuations occur.

The identification of a specific nuclear reaction involves use of the various procedures outlined above, and it is possible with reasonable accuracy to identify the various particles taking part in a nuclear reaction and to determine their energy. By measurement of coordinates in three dimensions on the photographic plate, the angles between the various particles can also be estimated. From these angles and the energies, and a prior knowledge of the predominant components in the emulsion, it is possible, using methods standard in Wilson cloud chamber investigations, to determine the particular nuclear event by a process of elimination. This process may be complicated by the emission of neutral or other particles not detected by a nuclear photographic emulsion.

Skill and experience play an important part in the identification of events, and in the time required for scanning a plate. A skilled observer can scan a 2-inch × 2-inch plate in two to three days. With careful training, unskilled observers can be used for the initial scanning of the plates, as this process is extremely slow and tedious, particularly in cosmic ray research, where the frequency of events of interest is low, and large numbers of plates must be scanned.

8. *Conclusions*

The nuclear photographic-plate technique, although not straightforward, represents an extremely useful addition to the variety of tools available to the nuclear physicist. With good organization of processing techniques, scanning, and projection-printing methods and equipment, it is capable of giving consistent and accurate results covering a wide variety of problems. The methods described in this paper, although not necessarily representing the only processing and organization procedures, are those of a very successful group at Bristol, and the author is indebted to the various members of this group for much of the information presented.

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See also general references listed in footnote, page 57.

AUSTRALIAN SCIENCE ABSTRACTS

THE attention of readers is drawn to the enquiry regarding their use of *Australian Science Abstracts*, which appears in the advertisement section of This JOURNAL, page xxvi.

Discovery of Devonian and Carboniferous Rocks in the North-West Basin, Western Australia

CURT TEICHERT.*

Introduction

THE North-West Basin is one of the major artesian basins of Australia and covers an area of 40,000 square miles along the coast of the Indian Ocean between 22° and 28° S. latitude. The presence of Palaeozoic marine rocks here had been known since 1848, but the existence of a basin with artesian possibilities was not recognized until A. Gibb Maitland's reconnaissance in 1907. More accurately this structure may be described as a half-basin in which the prevailing dip is westerly, towards the Indian Ocean, although there is much local faulting and folding everywhere. After Gibb Maitland's pioneer work, notable contributions to the geology of the North-West Basin were made by F. G. Clapp and by H. G. Raggatt, and a summary of its geology, according to the state of knowledge in 1946, was given by the present writer (Teichert, 1947).

It was then believed that the oldest rocks in the basin were of Permian age, beginning with the 'Lyons Series', which consist chiefly of sandstones and boulder beds of glacial origin. From his own observations between 1938 and 1941 and earlier investigations by Rudd, Raggatt and others, the writer concluded that the Permian rocks of the Basin increased in thickness from south to north, and that the total thickness of Permian beds in the northern part of the Basin was in the vicinity of 10,000 feet. The Permian was known to be overlain by a small thickness (about 20 feet) of Jurassic, followed by about 2,200 feet of Cretaceous and by 700 feet of Tertiary. The total thickness of the sedimentary filling in the northern part of the Basin was thus believed to be between 12,000 and 13,000 feet.

In 1948 the Commonwealth Bureau of Mineral Resources, Geology and Geophysics initiated a programme of geological mapping in the North-West Basin. The Royal Australian Air Force photographed from the air a strip, about 35 miles wide, from the coast to the edge of the Basin, covering the country immediately south of the Minilya River. The author was commissioned by the Bureau of Mineral Resources to plan and supervise the geological mapping of this area by the Bureau's geologists. The field season of 1948 was devoted entirely to the study of the Permian and younger rocks, and it was not until the beginning of the 1949 season that the edge of the Basin was approached in order to map what were believed to be the basal beds of the Permian system. It soon became evident, however, that the Lyons Conglomerate in this part of the Basin is underlain by a thick series of Devonian and Carboniferous rocks whose presence had been entirely unsuspected. The area in which these rocks were first discovered and, so far as known at present, have their main distribution, is situated on Williambury Station at about 24° S. latitude and 110 miles inland from the coast.

Devonian and Carboniferous Sequence

Along the edge of the basin the contact between the Precambrian and the Palaeozoic was nowhere observed, but general field relationships and the study of the aerial photographs suggest that the contact here is a normal stratigraphical one, not a faulted one. The Precambrian gneisses form low hills from which much gravel is shed on to the flatter sedimentary country to the west. Consequently there is a belt of talus west of the Precambrian, which obscures the basal 100 feet or more of the sedimentary series.

The lowest beds found at this distance above the Precambrian are thin beds of hard grey limestone with corals and gastropods. It is probable that they are interbedded with shales, or possibly sandstones, which are not exposed. Limestones a few hundred feet west of the edge of the basin dip generally at not less than 45 degrees West, and high dips are maintained throughout a belt not less than half a mile wide. Further west dips begin to decrease, but are rarely less than 25 degrees.

The following section was observed and measured between the Precambrian and the Permian Lyons Conglomerate:

SYSTEM	FORMATION	LITHOLOGY	FOSSILS
Permian	Lyons Group	Sandstones, boulder beds	Typical Permian assemblages
Carboniferous	Williambury Sandstone, about 2000 feet	Sandstone, some conglomerates	——
	Moogooree Limestone, 900 feet	Limestone and dolomitic limestone, calcareous shale	Spiriferids, *Syringothyris*, *Rhipidomella*
Devonian	Munabia Sandstone, 2850 feet	Strongly current-bedded sandstones, some conglomerates	——
	Gneudna Limestone, 2500 feet	Limestones, shaly limestones, some grits towards top	Stromatoporoids, *Thamnopora*, *Syringopora*, *Productella*, *Hypothyridina*, *Tentaculites*, Nautiloids

* University of Melbourne

The total thickness of the pre-Permian sequence is in excess of 8,000 feet.

1. *Gneudna Limestone*. This is a fairly uniform series of limestones. In somewhat more detail the sequence is as follows (from above):

	feet
(c) Alternating grits and fossiliferous limestones (upper part rich in corals and stromatoporoids)	600
(b) Fossiliferous limestones, rich in rugose corals, stromatoporoids, brachiopods, *Tentaculites* and nautiloids	1200
(a) Softer rocks, poorly exposed, probably calciferous shales or sandstones with occasional fossiliferous limestone bands	700
Total	2500

The formation outcrops in a belt of flat country in which the limestone bands form outcrops a few inches to some two or three feet in height. Throughout the entire sequence the rocks are very fossiliferous. The brachiopods include various spiriferids, *Atrypa*, *Hypothyridina* and *Productella*, and suggest a Middle Devonian to possibly early Upper Devonian age of the beds. The nautiloids are of the actinosiphonate type common in the Australian Devonian elsewhere. Intercalation of grits towards the top of the formation indicates gradual transition to the immediately overlying sandstones of the Munabia Formation.

2. *Munabia Sandstone*. This formation has a very uniform lithology and consists for the most part of fairly fine-grained current-bedded sandstones with some conglomerate horizons in its upper part. No fossils have so far been found in these beds, which are most probably entirely of Upper Devonian age.

3. *Moogooree Limestone*. This is a rather uniform series of limestones and dolomitic limestones. In the upper half of the formation there are some fossiliferous horizons, one of which is rich in specimens of *Syringothyris*, a brachiopod which is characteristic of the Burindi Limestone in New South Wales and which occurs in Lower Carboniferous rocks all over the world. The rest of the fauna includes a number of productids and spiriferids and a large *Rhipidomella*. This fauna is quite unlike any of the Permian faunas which occur in the rocks higher up in the sequence. It is here regarded as Lower Carboniferous, mainly on the strength of the presence of *Syringothyris*, although it is realized that in India this genus probably occurs as late as in early Permian time.

4. *Williambury Sandstone*. This rests conformably on the Moogooree Limestone, but the lithological change is sharp. This Formation has not yet been studied and measured in detail. As a rule conglomerates seem to be characteristc of the lower part, whereas the middle and upper parts of this Formation consist of fine-grained sandstones, very similar to those of the Munabia Formation, though distinctly less current-bedded. Although so far the Williambury Sandstone has yielded no fossils, its stratigraphical position seems to suggest an Upper Carboniferous age.

This entire sequence of more than 8,000 feet of sandstones, conglomerates and limestones is entirely comformable. Unfortunately, however, the stratigraphic relationships between the Williambury Sandstones and the overlying Lyons Group of early Permian age are as yet unknown. Wherever seen during these investigations the contact between rocks of these two ages was a faulted one. No violent unconformity may, however, be expected to exist. Although the area is strongly disturbed by young (Tertiary) faults, Carboniferous and Permian beds, in their respective fault blocks, have very much the same attitude and general dip.

Little can be stated about the continuation of the Devonian and Carboniferous belt north and south of the Minilya River area. It is most likely that it will be possible to follow it northward for some distance in undiminished width. Towards the south, conditions along the edge of the basin are complicated by faulting, but outcrops of pre-Permian rocks may occur as far south as the Arthur River, for Raggatt (1936) noted limestones with *Rhipidomella* below boulder beds of the Lyons Group.

Structure and Palaeogeography

The present eastern margin of the North-West Basin does not coincide with the eastern border of the old basin of sedimentation. This is evident from the nature of the basal sediments, which are not those of a marginal transgressive sea. Also, downfaulted outliers of Palaeozoic rocks exist in the Precambrian area east of the basin. Finally, the surface of the Precambrian at the edge of the basin now dips at about 45 degrees to the West, which is considerably more than the initial dip of the Devonian sea-floor. There is no doubt that the Palaeozoic sediments must once have extended considerably further east than their present area of distribution and that the marginal areas of the old basin were uplifted along faults and monoclinal folds, giving the remainder of the basin, as now preserved, its steeply dipping easterly margin. The sediments farther east were mostly eroded away, except in some less elevated fault belts at no great distance from the present basin. The width of this eroded belt of Palaeozoic sediments can hardly be estimated, but must have been of the order of at least some tens of miles.

The history of the North-West Basin can now be traced back to a much more distant geological past than before. It is evident that the sea here occupied a strip at least 150 miles wide as far back as the Middle Devonian. The sediments of Gneudna Formation indicate deposition not very close to the shore. In the upper part of the formation there is evidence

of increased terrigenous sedimentation which was predominant when the Munabia Sandstone was deposited. In the earlier Carboniferous (Moogooree Formation) we witness a return to palaeogeographic conditions resembling those of the Middle Devonian, whereas the Williambury Sandstone of probably Upper Carboniferous age is a recurrent facies duplicating conditions of the Upper Devonian. For some time during the early Permian, the area stood either slightly above or below sea-level, and formation of tills alternated with the deposition of glacio-marine beds, fossiliferous grits and calcareous sandstones.

The deposition of the Callytharra Limestone, in early Artinskian time, brought a recurrence of conditions resembling those of the Middle Devonian and Lower Carboniferous, and the area remained submerged until well past the middle of Permian time.

The result of these events was the deposition of not less than 18,000 feet of Palaeozoic conglomerates, sandstones, shales and limestones. Add to these about 3,000 feet of Cretaceous and Tertiary sediments which crop out near to the present coast, and it will be seen that the total thickness of the sedimentary filling of the northern part of the North-West Basin, as now known, exceeds 20,000 feet.

Some General Conclusions

The new discoveries are significant in several respects.

1. *Oil Prospects.* Obviously the addition of several thousand feet of sandstone, shale and limestone to the sedimentary column of the North-West Basin must have a favourable influence on our picture of the oil possibilities of the area. It also has a direct bearing on the future planning of exploration work. In 1947 the writer pointed out that, if it exists at all, Permian oil will probably not be found in the Permian outcrop areas, but farther west where the Permian rocks are covered by younger sediments.

In the coastal belt of the basin, the presence of numerous closed structures is known, and some of them have been mapped. Very little attention has, however, been given to the thickness and nature of the sediments below these structures. In most of the domes and anticlines, Upper Cretaceous or Lower Tertiary strata are exposed in the cores, and it is now clear that in most of them at least 18,000 or 19,000 feet of sediments will have to be penetrated before the Precambrian basement is reached.

Very little attention has so far been given to the presence of closed structures in the Permian belt itself, because most of the known structures are situated fairly low in the Permian, and the thickness of sediments in them was believed to be too small to warrant further exploration. The picture has now changed fundamentally. Thicknesses exceeding 8,000 or 9,000 feet may be expected in structures where even the lowest part of the Permian is exposed.

Thus, the discovery of a thick pre-Permian section has greatly increased the potentially oil-bearing area in the North-West Basin and it is clear that exploration work in all parts of the basin will be faced with scientific and technical problems of a greater magnitude than has been realized before.

2. *Age of Late Palaeozoic Glaciation.* The Permian rocks of the North-West Basin were at first regarded as Carboniferous (Maitland, 1907). Some of the fossil faunas were described by Etheridge and most of these came from the Callytharra Limestone. Only a few fossils were then known from the higher parts of the Permian sequence and their stratigraphical position with respect to the Callytharra faunas was unknown.

As Permian faunas in other parts of the world, particularly in India and Timor, became better known, the Permian affinities of the 'Carboniferous' faunas of Western Australia were realized, and the rocks containing them were classed as Permo-Carboniferous. This also became standard practice in eastern Australia and the boundary between the Permian and Carboniferous was drawn at some arbitrary level, usually at the base of the first richly-fossiliferous horizons.

Raggatt and Fletcher (1937), however, showed that the faunas of all 'Permo-Carboniferous' beds in Australia were so uniform and of such strongly Permian aspect that no further basis existed for the separation of some of them as Carboniferous. The whole sequence, including the basal glacial series in various parts of Australia, was now regarded as Permian. The present writer (1941) believed that the beginning of the glaciation in Australia took place in early Sakmarian, possibly latest pre-Sakmarian, time. Although these correlations were accepted by most Australian geologists, the glacial series of New South Wales (Lochinvar Group) is still referred to Upper Carboniferous by Browne (1947).

Recent field work in the North-West Basin has confirmed the fact that there is gradual transition from the Lyons Group into the overlying Callytharra Limestone. The fossils of the Lyons Group which occur in grits and calcareous sandstone horizons are closely related to the post-Lyons faunas; that is, they are of a wholly Permian aspect.

Unfortunately, it has not yet been possible to elucidate the relationships of the Lyons Group to the underlying rocks. There is, however, a very definite lithological break between the Williambury Sandstone and the sandstones and glacial beds of the Lyons Group. The stratigraphical position of the lowest fossil beds in the latter is not yet well known, but the first appearance of fossils is obviously determined by physical environmental factors and not by geological age of the beds. In view of these facts and of considerations set forth previously (Teichert, 1941), it would seem unnatural and impracticable to draw the boundary between

Permian and Carboniferous in the North-West Basin anywhere except at the base of the Lyons Group.

3. *Gondwanaland and the Age of the Indian Ocean.* When the idea of a great southern continent in Palaeozoic times was first conceived by Blandford in 1875, knowledge of the geology of the countries of the Southern Hemisphere was very scanty. More particularly Western Australia was then little more than a blank space on the geological map. Since the establishment of a permanent Geological Survey of Western Australia in 1896, steady progress has been made in the geological exploration of the sedimentary rocks in this part of the continent, but the work was very slow in gaining recognition abroad. As an example it may be mentioned that, although the existence of a marine basin of younger Palaeozoic rocks in Western Australia between 23° and 28° S. latitude (the North-West Basin) had been discovered by Gibb Maitland as early as 1907, Alfred Wegener was under the illusion, right up to the last (4th German) edition of his well-known book in 1929, that the connexion between Australia, India and Africa had not been severed until Jurassic times. But this was no exception, for the idea of the great Palaeozoic continent, Gondwanaland, lingered on in text books and most geological discussions until well into the late nineteen twenties. In subsequent years the actual facts became better known abroad, thanks mainly to two comprehensive reviews of Late Palaeozoic Gondwana stratigraphy by Schuchert (1928, 1935), and the date of the 'breaking up' of the southern continent had to be advanced, by two geological periods, to early Permian times. Besairie's discovery of marine Permian in Madagascar had proved the presence of a sea in the western half of the Indian Ocean in Upper Permian times. The idea, however, of a great southern continent, Gondwanaland, persisted. Current thoughts were ably expressed by Stille (1944) who wrote that Gondwanaland existed undisrupted until the Permian, and by Fairbridge (1948) who concluded that 'the first signs of a break-up in Gondwanaland occurred thus towards the end of the Permian'.

The discovery of thick Devonian and Carboniferous beds in Western Australia, extending southward probably at least as far as 25° S. latitude, shows that the Indian Ocean, at any rate its eastern half, is much older than has been suspected. The sediments of this age reflect an alternation of near-shore and offshore conditions, but on the whole they suggest the presence of a wide open sea covering marginal parts of Western Australia and extending westwards from the present continent. The northern extension of this sea is found in the Kimberley Division of Western Australia (Teichert 1947), Dutch New Guinea, and south-eastern Asia. This was the ancestral Indian Ocean, whose existence we can now trace back to at least Middle Devonian times. Once more the 'breaking up of Gondwanaland' has been advanced by another two geological periods. It seems that as early as Devonian times Australia was entirely surrounded by the sea and clearly recognizable as a separate continental unit.

Acknowledgements

The present paper is a preliminary account of work done under the auspices of the Bureau of Mineral Resources, Geology and Geophysics, of the Department of Supply and Development; the author is indebted to Dr. H. G. Raggatt for permission to publish the results in this form. He also wishes to express his thanks to Messrs. G. A. Thomas and C. Pritchard, geologists of the Bureau, for their efficient co-operation in the field.

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Education of the Scientist*

3. Student Wastage in Universities

STUDENT SELECTION AND ACADEMIC SUCCESS IN AUSTRALIAN UNIVERSITIES. By C. Sanders. (Sydney: Commonwealth Office of Education, Education Series, No. 1, 1948. 158 pp.) Price, 9*s.* 6*d.*

THIS book is a review of some twenty detailed investigations made in 1944-45, on

* This JOURNAL, *11*, 197.

behalf of the Universities Commission by Dr. C. Sanders, the Registrar of the University of Western Australia. It discusses student survival and the factors that contribute, such as entrance qualifications, intelligence and age; the effect of Faculty prerequisites on students and on schools, of war-time selection policies on the University; the prediction of academic success; and it ends with a thoughtful chapter on educational opportunity in the Australian Universities.

The survival rate is around 50 per cent. To a regimental commander this would be horrific: but the details are worse still. For instance, in 1934 only 18 per cent. completed their degrees at Melbourne in the minimum time, and 43 per cent. in 8 years. At Perth, in the period 1938-41, 22 per cent. completed their courses in the minimum time. In the Melbourne Medical School, 48 per cent. of students enrolling during 1933-35 graduated in 6 years; in 1942 this had risen to 77 per cent. (The last figure refutes the assertion that on the outbreak of war all the best students enrolled in the armed forces, and also shows some of the effect of a more rigorous selection policy.) The main wastage takes place in the first year—in Science Faculties it is 30 per cent. for all Universities, the range being from 60 (Tasmania) to 20 (Sydney) with Melbourne at 43. These figures are astonishingly constant and must to some extent reflect differences in University policies.

Several facts are relevant to a broader discussion of this wastage. Dr. Sanders points out that nearly all pupils who are able to pass Matriculation are also sufficiently intelligent to pass University examinations. In a series of detailed analyses he shows that intellectual capacity alone as a predictor of academic success is no better than are the results of the School Leaving Certificate examination. A major factor is, of course, univariate selection. In other words, intelligence is necessary, but not by any means sufficient; some other variables being personality traits and aptitudes like interest, ambition, reading ability, application, study habits, stability; and, on the other hand, environmental variables like economic conditions, friendship groups, location, home conditions and early training.

Sanders estimates that not less than 8 per cent. of the school population has all the potentialities needed to obtain a University degree. Before the war, the Australian University population was 14,000 (1·26 per cent.); but if all who were potentially capable had entered, it would have been 90,000. The reader may like to speculate what life in the Universities would be like if the best 1·26 per cent. of the best 90,000 had been chosen by really comprehensive psychological and educational selection procedures, and what the figures would be if *all* school-children were given adequate educational and vocational guidance throughout their careers.

That outside economic factors are more important than fees, is shown by the 'free' University of Western Australia, in three ways: in 1939 the average wastage was as elsewhere; the University enrolment per head of population was about the Australian average and less than half that of South Australia; and the number of students expressed as a percentage of school enrolment was less than at Melbourne.

Perhaps the most interesting and provocative chapter is that in which Sanders discusses the problem of Faculty prerequisites in relation to student selection and academic success.

He reviews Professor Cherry's statistical analyses of the relation between Leaving Certificate examination success and academic success, and the system of weighting employed by Melbourne in the war-time selection of students. He concludes that the system was statistically sound, and that the evidence supports the view that there should be probably even more prerequisites than most Matriculation regulations demand.

Here, however, statistical facts conflict with broad educational principles, which may be characterized by the phrase 'broad culture versus narrow specialism at school'. If the present first-year examination standards are maintained, parents at least will insist that schools give the necessary preliminary specialist training, particularly in the sciences. Of course, whatever standards or regulations the University adopts, they will affect school curricula and methods, since academic standards are relative and interdependent. So much for the complaints by schools about the crippling effect of prerequisites. *Ficta voluptatis causa sint proxima veris.*

The whole discussion of the relation of statistics to educational policy leads to the conclusion that no fundamental thinking about the purpose of a University education has been done for a very long time. Perhaps the imminent budding of a Technological Institute from the parent stem, as in Melbourne, is a good time to start—if enough University teachers can be found with leisure enough to think.

[From a review by O. A. Oeser in the *University of Melbourne Gazette*, 5, 43, June 1949.

The Papua and New Guinea Scientific Society

A Society which has as its object 'the promotion of knowledge and interest in the sciences, particularly in relation to the Territory of Papua and New Guinea', was formed in Port Moresby early in 1949. This is probably the first venture of such nature in the history of New Guinea. Within a few months the membership grew to over fifty scientists, doctors, engineers, geologists, surveyors, explorers and field naturalists. No formal qualifications for membership other than a declared interest in the objectives of the Society are stipulated in its constitution. Ordinary meetings are held

monthly at the Public Library in Port Moresby, and it is intended to inform members in outlying areas of the proceedings by means of bulletins. Branches in other centres in the Territory may be organized later.

The Society was formed with the double aim of promoting dissemination of information on scientific work done in the Territory and providing a centre where visiting scientists can meet the interested public and discuss their own research work. The programme of the monthly meetings held during 1949 shows how this intention is being carried out. In May, A. P. Dodd, M.B.E., Director of the Biological Section of the Queensland Lands Department talked on 'The Control of Prickly Pear in Australia'. This was followed by 'Surveying and Mapping in Papua-New Guinea', by S. E. Reilly, Staff Surveyor to the Lands Department, Port Moresby; and 'Town Planning', by J. O. Lyons, Director of Public Works. A Symposium on 'Natural Resources of the Territory of Papua-New Guinea' was held in July, and in August G. A. V. Stanley discussed the 'Geography of the Central Highlands of New Guinea'. The September Meeting was addressed by W. D. Forsyth, Secretary-General of the South Pacific Commission, whose subject was 'The South Pacific Commission and its Research Programme'. In October I. Champion, Acting-Director of District Services and Native Affairs and noted explorer, spoke on his 'Journeys from the Fly to the Sepik and from the Bamu to the Purari'. Further meetings are planned to deal with the subjects of health and nutrition, engineering in the Territory, aviation, etc.

His Honour Colonel J. K. Murray, Administrator of the Territory of Papua and New Guinea, is the Patron of the Society. His inaugural address at the first public meeting in April 1949 dealt with 'Science in the Future of Papua-New Guinea'. It will be published elsewhere in This JOURNAL.

Office bearers for 1949-50 are:
President—Dr. J. T. Gunther.
Secretary—Mr. R. D. Koch.
Treasurer—H. Parnell.
Councillors—C. L. Anthony, W. Cottrell-Dormer, R. E. P. Dwyer, Dr. M. F. Glaessner, W. Granger, N. A. Osborne, Dr. T. C. Richards.
Communications may be addressed to the Society, c.o. Public Library, Port Moresby.

News

Commonwealth Scientific Publications Committee

Following on a recommendation by the Council for Scientific and Industrial Research, supported by the Meteorological Bureau, the Forestry Bureau, and the Solar Physics Observatory, the Commonwealth Government decided in 1927 to provide financial assistance to meet the cost of publication of meritorious scientific works, the nature of which made it impossible for scientific organizations to undertake the cost of printing and expenses associated therewith.

The Commonwealth Scientific Publications Committee, which was then formed to consider applications for grants from the funds placed at its disposal by the Government, now includes Mr. J. Brophy, Chairman (First Assistant Secretary, Department of the Treasury), Dr. F. W. G. White (Chief Executive Officer, C.S.I.R.O.), and Dr. R. v. d. R. Woolley (Commonwealth Astronomer), with an additional member co-opted *ad hoc* as required on account of his special knowledge of the branch or branches of science concerned in each application.

Three essentials are necessary to secure financial assistance:

(i) the work must be of a very high standard of merit;
(ii) publication would be a distinct service to science;
(iii) publication of the work is, on account of its extent, beyond the financial capacity of any of the Scientific Societies or is not, on account of the probable limit on the number of purchases, acceptable to any commercial publishing house.

Since its formation, the Committee has aided the publication of Memoirs, Reports, etc., relating to the results of special investigations carried out in Australia, such as the *Study of the Meteorological Results of the First Shackleton Expedition* by Dr. Edward Kidson, *Phonetics and Grammar of the Aranda Language* by T. G. H. Strehlow, the *Geological Map of Australia* by Sir Edgeworth David, and many others.

Grants are usually made by payment of the printer's account where the financial assistance approved covers such cost, or in other cases to the author on receipt of evidence that the scientific matter has been printed. Applications, together with complete copies of manuscripts for consideration by the Committee, should be forwarded to the Chairman, Commonwealth Scientific Publications Committee, Department of the Treasury, Canberra, A.C.T.

Journal of the Zoological Society of India

The first issue of the *Journal of the Zoological Society of India* appeared in January. It is to be a half-yearly publication embodying original research and critical reviews. The annual subscription is *Rs*.22. Orders may be placed with the Secretary of the Society, Major M. L. Roonwal, c.o. Zoological Survey of India, Indian Museum, 27 Chowringhee, Calcutta—13.

D.R.L. Information Sheets

Information Sheets in duplicated typescript are being prepared from time to time by the Defence Research Laboratories (Private Bag

No. 4, P.O., Ascot Vale, W.2, Victoria), to answer specific enquiries addressed to the Laboratories. They are sent only on request to persons having need of the particular information in each Sheet. The following have been prepared up to the present.

S.1. *Rotproofing of Tents.* By W. R. Hindson. August 1949. The two-solution copper treatment and the copper soap and wax treatment are described.

S.2. *Etching Solution for Marking Steel.* By C. G. Baird. August 1949. Brands, trade marks, or part identifications, may be marked on clean steel parts by rubber stamp with the solution described. The mark can still be distinguished after hard rubbing.

S.3 *Disposal of Waste Fluorescent Tubes.* By A. A. Rosenblum. August 1949. Recommendations for handling, and general safety precautions, are described, to guard against poisoning from the inner coating which may contain beryllium compounds.

Federation of American Societies for Experimental Biology

The Federation of American Societies for Experimental Biology will hold its thirty-fourth annual meeting, 17-21 April 1950, at Atlantic City, New Jersey, with headquarters at the Hotel Traymore. Affiliated Societies are: The American Physiological Society; American Society of Biological Chemists; American Society for Pharmacology and Experimental Therapeutics; The American Society for Experimental Pathology; American Institute of Nutrition; and The American Association of Immunologists. In the scientific sessions, approximately 1600 papers will be presented in the fields of these Societies. In addition, there will be a Joint Session of all six Societies, and several symposia. Attendance will be open to members of the constituent Societies and their associates and to interested biologists in all countries.

Biologists in the fields represented by the Federation may submit titles and abstracts of papers they wish to read, to the Secretary of an appropriate one of the Societies, not later than 10 January 1950. Non-members must be introduced by a member. Scientific and technical exhibits may be made by individuals, laboratories, institutions and industrial organizations. Further information may be obtained from the Federation Secretary, 2102 Constitution Ave., Washington 25, D.C., U.S.A.

Obituary: Leslie William Phillips

The death of Leslie William Phillips occurred at his home in Mt. Lawley, W.A., on 10 May 1949. He was a man of wide interests. He took his first degree from Melbourne and began his teaching career there. During World War I he served with the Field Ambulance and was mentioned in despatches. After the war he turned again to teaching in Victoria and in 1920 he was appointed assistant lecturer in Chemistry at the Perth Technical College. He became Assistant Superintendent of Technical Education in 1929 and was appointed Superintendent in 1941.

During World War II, and in the peace that followed, Phillips carried a heavy burden of responsibility. He became Regional Director of Industrial Training and Chairman of the Dilution Committee, he was a member of a number of advisory committees on education in the services and, later, was responsible for the planning and implementation of the Commonwealth Reconstruction Training Scheme in Western Australia.

Because of his interest in youth and his wide training, Phillips was particularly qualified for the positions he occupied. He held senior degrees in Science and Education, was an Associate of the Australian Chemical Institute and of the Institute of Education of London and (as holder of a Carnegie Fellowship for Education) had studied technical education in England.

Phillips' publications were chiefly in the fields of chemistry and education. His research work in chemistry was restricted to the period spent in the Chemistry Department of the Perth Technical College. During this time he investigated and published an account of the oils of *Agonis flexuosa, Eucalyptus campaspe* and *E. spathulata.* He was subsequently attracted to the difficult problem of the toxic principles of the genera *Oxylobium* and *Gastrolobium.* His publications on education included a series of booklets on the history and development of technical education, together with one, produced in collaboration with Dr. K. S. Cunningham, on *The Future of Education.*

In his outside activities, Phillips was again devoted to the causes of science, education and youth. He was secretary of the State Committee of C.S.I.R. for many years, and was a member of the Western Australian Division of A.N.R.C. He was actively associated with the Australian Chemical Institute from 1930 almost continuously until 1943, when he was General President. During much of this time he was also an active member of the Royal Society of Western Australia, on the Council of which he served for fifteen years, eight of which were in the capacity of secretary. He was a member of the State Committee of A.C.E.R., a member of the Faculty of Education of the University of Western Australia, and a very active member of Legacy. The position which he occupied in the fields of science, education and youth welfare is perhaps indicated by the fact that he occupied the Presidential chair of the Australian Chemical Institute, the Royal Society of Western Australia, the State Branch of A.C.E.R. and of Perth Legacy.

Sir Ben Lockspeiser

On 1 May, Sir Edward Appleton was succeeded by Sir Ben Lockspeiser, M.A., M.I.Mech.E., F.R.Ae.S., as Secretary to the Committee of the Privy Council for Scientific and Industrial Research, in the United Kingdom. Prior to Sir Edward Appleton (1939-1949), the previous holders of the appointment have been: Sir Frank Heath (1916-1927), Sir Henry Tizard (1927-1929) and Sir Frank Smith (1929-1939).

Sir Ben Lockspeiser was educated at the Grocers' School, at Sidney Sussex College, Cambridge (where he took the Natural Sciences Tripos Part I and the Mechanical Sciences Tripos), and at the Royal School of Mines. During the 1914-1918 war he served with the R.A.M.C. as a private and participated in the discovery that a disease which was causing fatal casualties in the forces in Egypt was amoebic dysentery, rather than bacillary dysentery. He was subsequently allocated to the Admiralty Steel Laboratory. For the seventeen years from 1920, he was a research worker at the Royal Aeronautical Establishment, Farnborough, and in 1937 was appointed Head of the Air Defence Department. In following years he occupied senior positions with the Air Ministry and the Ministry of Aircraft Production. In 1946 he was appointed Chief Scientist at the Ministry of Supply, and as such was responsible for the conduct of scientific research in all fields of activity of the Ministry excepting atomic energy. He has recently been elected a Fellow of the Royal Society.

National Physical Laboratory: E. C. Bullard

Sir Charles Darwin is to be succeeded, as Director of the N.P.L., by Professor E. C. Bullard, of the University of Toronto. Professor Bullard is forty-one years of age. He studied Physics at Clare College, Cambridge, where he later devised and improved methods of recording the times of swing of pendulums in order to determine the force of gravity in the field. As Smithson Research Fellow of the Royal Society, from 1936 to 1939, he took up geophysical methods of determining the geology of the earth's crust, especially the depth of the Palaeozoic floor in East Anglia. During the war he was concerned with the de-gaussing of ships and with measures against the acoustic mine, and became Assistant Director of Naval Operational Research. He was made a Fellow of the Royal Society in 1941, elected a Fellow of Clare College in 1943, and appointed Professor of Physics at Toronto in 1948.

Platinum/Rhodium-Platinum Thermocouples

A revised edition of *Platinum:Platinum-Rhodium Thermocouples* (issued as 'Publication 1550' by Johnson, Matthey and Co. Ltd., Hatton Garden, London, E.C.1) gives an account of methods by which the reliability and reproducibility of these couples are ensured during production and testing. Details are given of the quick-immersion method of measuring liquid steel temperatures, and of the modified techinique now adopted in grey-iron foundries. The revised International Temperature Scale has had the effect of adjusting the accepted melting points of silver, platinum, palladium and other metals of high melting points. A new set of calibration tables has been worked out by the National Physical Laboratory, and is included in the new edition of the booklet. Copies are available on application, from Garrett, Davidson and Matthey Pty. Ltd., 824 George Street, Sydney.

Australian Pulp and Paper Industry Technical Association

The Third General Conference and Annual General Meeting of the Australian Pulp and Paper Industry Technical Association was held in Stawell Hall, Sydney, during the period 21 to 25 February 1949. The Conference was opened by the President of the Association, H. B. Somerset, and consisted of seven technical sessions at which twenty-one papers were presented by both technical and operating workers from the paper companies within Australia, Tasmania and New Zealand, and the Division of Forest Products, C.S.I.R.

On the technical side, papers dealt with the influence of base-exchange phenomena and high-polymeric non-fibrous addition agents to the properties of pulp and paper; a survey of basic density, green density and moisture content of *Pinus radiata* grown in New Zealand; and work on the chemistry of eucalypt woods carried out by the Division of Forest Products.

Practical aspects were covered by papers dealing with the production of mechanical pulp from eucalypt wood; work carried out on the temperature of wood near the surface during grinding; and the brightening of eucalypt groundwood by pre-treatment with acid and extraction with alkali. Other practical papers covered the manufacture of paperboard, wallboard, and coated boards and papers. The subject of pulping was covered by two papers dealing with particular aspects: two-stage counter-current pulping, and soda recovery and losses in kraft pulping.

The papers on engineering subjects dealt with the correct selection of centrifugal pumps, and preventive mechanical maintenance in paper mills. A symposium was held on paper testing, introduced by a discussion on the conditions of relative humidity and temperature for paper testing in Australia. This was followed by a specific paper on the measurement of internal tearing resistance, and two papers dealing with the calibration, maintenance and correlation of paper-testing instruments. Of wide interest were papers on cost determination in the industry, and warehousing as practised at the Burnie Mill of Associated Pulp and Paper Mills Ltd.

The social side was covered by a cocktail party at 'Keston', Kirribilli, at which the

guests included C. K. Jacka (deputizing for the Hon. Geo. Weir, Minister for Conservation) and R. K. Murphy, Principal of the Sydney Technical College. Approximately sixty visitors from New Zealand, Tasmania and Victoria attended the Conference, together with members of the Association from the Sydney area.

At the Annual General Meeting the results of elections were announced, and the present personnel of the Interim Executive Committee is: President, H. E. Dadswell; Vice-President, L. R. Benjamin; Immediate Past President, H. B. Somerset; Committee, K. S. Bull, W. E. Cohen, G. W. Ellis, A. C. Fisher, D. E. Hale, J. L. Somerville, G. H. Wiltshire.

The Presidential Address by H. B. Somerset was given at the conclusion of the Annual General Meeting. A full-day visit was paid to the Botany mill of the Australian Paper Manufacturers Ltd.

Australian National University

Professor K. C. Wheare, formerly a Victoria Rhodes Scholar and now Gladstone Professor of Government and Political Administration at the University of Oxford, has been appointed to the Academic Advisory Committee, which also includes Sir Howard Florey, Professor Marcus L. Oliphant and Professor Raymond Firth. Professor W. K. Hancock, who was formerly a member of the Committee, has been appointed Director of the Institute of Commonwealth Studies in the University of London. Professor Wheare visited Australia in August. R. A. Hohnen, formerly Registrar of the New England University College, Armidale, and latterly Acting-Registrar of the National University, has been appointed Registrar in succession to R. G. Osborne. Maurice Brown, of the University of Melbourne and Secretary of the Nuffield Foundation Advisory Committee, has been appointed Assistant to the Registrar.

The first appointment to the Research School of Social Sciences is that of Professor Geoffrey Sawer, to the Chair of Law. Professor Sawer has been Associate-Professor in Melbourne; during the war he was in charge of short-wave propaganda to Japan. The work of the Department of Law is to concentrate upon problems of Constitutional Law and the legal basis of the social and economic structure, as a contribution to research in social sciences.

In the School of Pacific Studies, W. R. Crocker has been appointed to the Chair of International Relations. Professor Crocker is a graduate of the University of Adelaide and of Balliol College, Oxford. He went to Stanford University, California, as a Commonwealth Fund Fellow, and before the war he had experience in the British Colonial Service and in the International Labour Office. During the war he was awarded the Croix de Guerre and Belgian Ordre Royal du Lion and attained the rank of Lieutenant-Colonel. Since 1946 he has been Chief of the Africa Section of the Trusteeship Department of the United Nations.

The recent visit of Professor Oliphant has enabled plans to be finalized for the building of the Research School of Physical Sciences. It is intended to include an Accelerator, for research in nuclear physics, which will have double the power of that now being installed by Professor Oliphant in his laboratory at Birmingham. A considerable amount of steel will be required for this equipment. As much material as possible, for the building and its equipment, will be secured from Australian sources, and the balance from the United Kingdom. A sufficient portion of the building (the workshop and the accelerator wing) is to be erected to allow Professor Oliphant to supervise the installation of equipment in the latter part of 1950, when he intends to commence his work in Canberra.

Discussions on the laboratory for the John Curtin School of Medical Research recently took place in Oxford between Sir Howard Florey and Professors Ennor, Albert and Fenner. Dr. A. Sanders, who is a Senior Research Officer at Oxford under Sir Howard Florey, visited Australia in August to complete the discussions. It is expected that building will commence early in 1950. Plans have been completed for five houses and twenty-four flats for University staff. Foundation stones of the Medical and Physical Schools, and of University House (the residential college) are to be laid on 24 October.

University of M-ᵗ

The new Chair of Economic History has been filled by the appointment of J. A. La Nauze, who has been Acting Professor of Economics in the University of Sydney. Professor La Nauze is a former Rhodes Scholar of Western Australia and resided at Balliol College, Oxford. S. B. Hammond has been promoted in grade from lecturer to senior lecturer in Collective Behaviour (School of Psychology); and A. M. McBriar in History. E. E. Ward, of Canberra, has been appointed senior lecturer in Political Science; D. L. Adler, of San Francisco State College, as senior lecturer in Psychology for one year; Miss M. J. Matheson, at present in Cambridge, as lecturer in Botany.

Recommendations have been made by the Professor of Metallurgy through the Faculty of Engineering, and subsequently confirmed by the Professorial Board, for the establishment of a separate Department of Mining, with the addition of an additional lecturer in Mining and a research Fellow in Ore Dressing. J. C. Nixon, of the University of Illinois, has been appointed senior lecturer in Mining.

Travel grants of £150 sterling have been made by the British Council to seven members of the staff, including Kurt Baier (Philosophy), D. J. Swaine (Chemistry, to Aberdeen), J. F. G. Darby (Physics, to Oxford), F. Lazlo (Engineering, to Cambridge), A. S. Buchanan (Physical Chemistry, to Oxford). L. A. I. Maxwell (Clinical Biochemistry and Therapeutics), has also been granted leave for 1950.

Development of the Department of Meteorology has included the initiation of research on seasonal forecasting of weather. Dr. H. M. Treloar (previously of the Commonwealth Meteorological Bureau) is leader of the research team, and Miss Alison Grant has been appointed research assistant. Dr. Fritz Albrecht, who has commenced research work in the Department, is an authority on atmospheric radiation and heat economy. He was formerly Vice-Director of Meteorological Services in the Russian Zone of Occupation of Germany and was brought to Australia by the Commonwealth Government in order to develop a centre for the study of problems related to atmospheric radiation.

The degree of Doctor of Science has been awarded to T. R. Scott, of the Division of Industrial Chemistry, C.S.I.R.O., for work upon the chemistry of inorganic fluorides and uranium ores. The degree of Doctor of Philosophy in Agriculture has been awarded to P. S. Parsai, an Indian Government Scholar who has been engaged upon investigation of citrus virus disease. He is the first overseas candidate to qualify for the Ph.D. degree. The Bertram Armytage Prize for clinical research has been awarded to G. E. M. Scott. The Ernest Scott Prize for Australian historical studies has been awarded to A. H. McLintock, for his 'History of Otage—the Origins and Growth of a Wakefield Class Settlement'.

After being in abeyance for three years, the regulations requiring Science students to have a knowledge of French and German translation have been again brought into effect. The subject of Psychology is to be recognized as one of the Schools for the degree of Master of Science.

The association of the Canberra University College with the examinations and degrees of the University of Melbourne has been extended until the end of 1951. It appears that incorporation of the College into the Australian National University will thus not proceed for at least the next two years.

Recent benefactions include: £1,000 as an instalment from an anonymous donor for the building of a Child Development and Research Centre in connexion with the Department of Psychology; an instalment of £250 from the Victorian Chamber of Manufactures; an annual instalment of £300 from the State Electricity Commission of Victoria, for research on brown coal; £100 from G. J. Coles and Co., for the Department of Visual Aids; £150 from Australian Paper Manufacturers Ltd., for research in the Department of Chemistry; mineral specimens from L. A. Crozier, for the Department of Geology; £50 from Investo Manufacturing Pty. Ltd., for the Department of Metallurgy; £100 from The Sidney Myer Charity Trust, for the Department of Visual Aids; and a total of £1042 from thirteen other donors.

The decision to close the Mildura Branch of the University has been due to the reduction in numbers of incoming First-year students. To keep the student population to a size which would justify the continuance of the experiment would have required the transfer of more courses to Mildura, involving an uneconomic addition to equipment and an impossible addition to staff.

University of Sydney

The first George Arnold Wood Memorial Lecture, established in memory of the former Professor of History in the University, was delivered on 19 September, when Professor F. L. Wood spoke upon the subject, 'The Historian in the Modern Community'. A lecture on 'The Nucleus of the Atom and Atomic Energy' was delivered on 23 September by Professor H. S. W. Massey, of University College, London.

The degree of Doctor of Dental Science has been conferred upon A. G. H. Lawes.

The following members of staff have been promoted in grade: G. D. Osborne, to be Reader in Geology; F. Chong, to be senior lecturer in Geology; G. F. Humphrey, to be senior lecturer in Biochemistry; A. G. Hammer, to be senior lecturer in Psychology.

There have been a number of movements of personnel connected with the Department of Chemistry. I. G. Ross has resigned his lectureship in Physical Chemistry to become a National University Fellow; he is proceeding to the University College, London. Following this retirement, N. A. Gibson becomes a lecturer in Inorganic Chemistry. J. N. Phillips, a teaching Fellow until February 1949 and thereafter a lecturer at the Sydney Technical College, has also been awarded a National University Fellowship, and hopes to work under Professor E. K. Rideal at the Royal Institute, London. I. R. Wilson has been appointed assistant lecturer in Chemistry in the University of Queensland; N. S. Hush has accepted an appointment as lecturer in Chemistry in the University of Manchester. Miss J. Northcott, teaching Fellow, is leaving to take up a postgraduate Fellowship at the Washington University, St. Louis, U.S.A. D. McGrath (Dunlop Rubber Scholar), Miss D. Marmion and Miss P. M. Stubbin have left to continue work in the United Kingdom. B. M. Smythe (temporary lecturer), D. R. Warren (temporary lecturer), R. A. Durie (research assistant), and C. L. Cook (graduate assistant to the Vice-Chancellor and formerly member of the Department of Chemistry) have joined the Long Range Weapons Development Establishment, for postgraduate research in the United Kingdom, probably in the University of London. H. G. Holland has been appointed to one of the vacant teaching Fellowships.

The New England University College, which last year received a gift of an adjacent farm property of 265 acres, has received a further 40 acres as gifts from the White family. The future establishment of teaching in animal

husbandry and agricultural science is contemplated.

The following donations have been received: £1,000 from the Colonial Sugar Refining Co., for the Chemistry Department, and £250 for the Chemical Engineering Department; £2,000 under the will of Elsie May Almond, for research in Veterinary Science; £1,500 as an additional sum from Meggitt Ltd., for research in Agriculture; £200 from Reckitt and Colman (Australia), for the Department of Obstetrics; £100 from H. J. Swain, for a prize in Mechanical Engineering; a Sorvall Angle Centrifuge from the Rockefeller Foundation, for use in biochemical research in blood disorders, in the Department of Surgery; £450 from the C.S.I.R.O., for fundamental plant disease investigations in the Department of Agriculture; £250 from the Australian Jockey Club, for the Department of Veterinary Science; £50 from Hermon Slade, Junior, for the Department of Chemistry.

University of Queensland

The Main University Building at St. Lucia was formally declared open for teaching purposes in a ceremony held on 5 May 1949. The University has been housed in the old Government House near the city from 10 December 1910. The Premier, in his speech, laid special stress upon the need for adding residential colleges and referred to plans for establishing University Colleges in Central and Northern Queensland. It is expected that the total costs of building at St. Lucia will be over one million pounds. The honorary degree of Master of Engineering was conferred upon John Robert Kemp, the Co-ordinator General of Public Works for Queensland, who has been chairman of the University Works Board and of the Building and Grounds Committee.

Professor Mansergh Shaw, who is the first appointee to the Chair of Mechanical Engineering, is a graduate of the University of Sheffield. Since 1938 he has been senior lecturer in the University of Melbourne, where he has been responsible for the design and manufacture of much research and developmental equipment, especially during the war period.

The Goddard Memorial Fund, amounting to £500, has been handed to the Barrier Reef Committee, and will be used for the establishment of a memorial unit to the late Professor E. J. Goddard, in a Marine Biological Research Station. Richard Gradwell, who has been awarded an 1851 Exhibition Scholarship and has been working on the granites of south-eastern Queensland, will proceed to research under Professor H. H. Read at the Imperial College of Science.

University of Tasmania

The curriculum for the degree of Bachelor of Laws has been revised and the course will henceforth extend over five years. Professor E. E. Kurth has been granted leave of absence for a year to visit Europe and America. He proposes to leave in February.

University of Western Australia

A. F. Wilson, of the University of Adelaide, has taken up his appointment as senior lecturer in Geology. His main interests lie in the mineralogy-petrology phase of geology and his research work has been mainly on the charnockitic rocks of the Musgrave Ranges. On completion of this work he proposes to investigate Western Australian granites with a view to their correlation and to the determination of their relationships with mineralization.

P. J. Coleman, who is this year Senior Research Fellow in Palaeontology in the University, is working principally on Western Australian Devonian and Permian faunas. His attention has been given mainly to a close study of the genus *Atrypa*. He is also continuing his earlier studies of the Tertiary foraminifera of the Perth Basin.

Robert Kirk, who has joined the staff of the Department of Zoology, is a graduate of the University of Birmingham. He acted as research assistant to Professor Lancelot Hogben and lectured in England both for the Workers' Educational Association and for the Central Council for Health Education. In 1946 he was appointed Associate Professor of Physiology at Sarah Lawrence College, New York.

P. L. Scutt, who has been appointed lecturer in Biochemistry in the Institute of Agriculture of the University, was previously senior demonstrator in Biochemistry in the University of Melbourne. For the past three years he has carried out research under the direction of Associate Professor W. A. Rawlinson upon the physical properties of blood pigments.

Professor N. S. Bayliss is leaving for the United States of America early in November, on study leave. He is to return through England, after an absence of about ten months.

University of New Zealand

Professor J. A. Bartram, who had been in charge of the Department of Geology at Auckland University College since 1913, died in the early part of July. Professor R. Speight, who had been in charge of the Department of Geology in Canterbury University College, Christchurch, from 1903 to 1930, and Curator of the Canterbury Museum from 1914 to 1935, died early in September. Both were active investigators and published a large number of valuable geological papers.

Dr. S. N. Slater, senior lecturer in Chemistry at the University of Otago, has been appointed to succeed Professor P. W. Robertson in the Chair of Chemistry at Victoria University College.

University of Otago

Professor J. I. Graham, formerly Advisor on the Scientific Aspects of Underground Problems to the National Coal Board of Great Britain,

has commenced duties as Professor in the newly-instituted Chair of Coal Mining at the School of Mines and Metallurgy within the University. He will co-operate with the Department of Scientific and Industrial Research in conducting special investigations into New Zealand coal problems.

Dr. T. S. Ma, formerly of the National University at Peiping, has commenced duties in the newly-instituted lectureship of Microchemistry. Dr. D. A. Brown, formerly of the Geological Survey of New Zealand, has been appointed senior lecturer in geology, and W. A. Watters as assistant lecturer in Geology. Dr. A. G. McClellan has been appointed lecturer in Physics and W. S. Fyfe as assistant lecturer in Chemistry. J. Rogers, research lecturer in Mineral Dressing, has been awarded a Nuffield Fellowship and has left for a period of advanced study in the United States of America.

Personal

Kathleen Law, formerly lecturer in Biochemistry in the University of Melbourne, who has been abroad on leave from that University, has been appointed to the staff of University College, London.

The death has occurred of Lady Lyle, widow of Sir Thomas Lyle, formerly Professor of Natural Philosophy in the University of Melbourne.

Miss Eder Lindsay, former research officer in Agricultural Entomology in Melbourne, has been awarded the Ph.D. degree in Pharmacology and Toxicology of the University of California.

Professor W. K. Hancock, of the University of Oxford and formerly of Adelaide, has been appointed Director of the newly-formed Institute of Commonwealth Studies, in the University of London, with the title of Professor of Commonwealth Affairs.

Professor H. R. Hamley, of the London Institute of Education, whose death is reported, was a graduate of the University of Melbourne. He was an educational psychologist notably successful in the relation of scientific principles to the problems of practical education.

International Scientific Conferences

1949

November 2-4—Electronics symposium, London.
November 3-10—V Animal Husbandry Congress, Paris.
November 7-8—Symposium on Ferromagnetic Metals, London.
November 14-16—Conference on Elementary Particles, Edinburgh.
November 16—Symposium on Metallurgical Applications of the Electron Microscope, London.
December 16-18—X Ornithological Congress, Washington.
December 26-31—116th Annual Meeting, American Association for the Advancement of Science, New York.

1950

February 28—Conference on Pneumosilicosis, University of Sydney.
March—Symposium on Hot-working of Non-ferrous Metals and Alloys, Annual General Meeting of Institute of Metals, London.
April—Colloquium on the Mechanism of Narcosis.
May 1-25—V General Conference, UNESCO, Florence.
May 8—IX Congress, Seed Testing Association, Washington.
May—General Assembly, French Chronometric Society, Lyon.
June—Commonwealth Plant Genetical Conference, U.K.
June—Review Conference, Commonwealth Agricultural Bureaux, U.K.
June 29-July 8—High Tension Conference, Large Electrical Systems, Paris.
July 1-15—I Congress of Cardiology, Paris.
July 3-9—Conference on Shale Oil and Cannel Coal, Glasgow.
July 3-8—Conference on Civil Engineering Problems in the Colonies, London.
July 10-15—IV Plenary World Power Conference, London.
July 11-14—Conference on Properties f Semi-conducting Materials, Reading.
July 12-20—VII Botanical Conference, Stockholm.
July—General Assembly, I.U. Biological Sciences, Stockholm.
July—VI Congress on Radiology, London or Cambridge.
July 17-21—XVI Conference of Ophthalmology.
July 17-26—International Meeting for Optical Science, London.
July 24-August 1—IV Congress of Soil Science, Holland.
July 25-28—International Anatomical Congress, Oxford.
August—VI Congress, I.U. History of Sciences, Holland.
August 17-24—V Congress of Microbiology, Rio de Janiero.
August 30-September 6—International Conference on Mathematics, Cambridge, Mass., U.S.A.
September—IX General Assembly, International Union of Scientific Radio, Zurich.
September—International Congress of Cell Biology, Yale.
October—International Rubber Conference, Cleveland, U.S.A.

Dates to be arranged, 1950

Annual Meeting, British Association for the Advancement of Science, Birmingham.
XI International Limnological Congress, Belgium.
XVIII International Congress of Physiology, Copenhagen.

The Scientific Societies

Royal Society of Tasmania

September: M. R. Banks, Radio activity and the age of the earth.
October: W. H. Hudspeth, A slab of Ancient History.
W. E. L. H. Crowther, Camping grounds of the Tasmanian aboriginals.

Royal Society of New South Wales

September: R. C. L. Bosworth, Anodic and cathodic polarization of copper in acetic acid.
F. P. Dwyer, The chemistry of ruthenium—III, The redox potentials of the ruthenium-II complexes with substituted derivatives of 2·2′ dipyridyl and O-phenanthroline.
J. R. Backhouse and F. P. Dwyer, The chemistry of ruthenium—IV, The potential of the quadrivalent/trivalent ruthenium couple in hydrochloric and hydrobromic acids.
J. R. Backhouse and F. P. Dwyer, The chemistry of ruthenium—V, The potential of the bivalent/trivalent ruthenium couple in hydrochloric acid.
H. Wood, Kepler's problem.
D. P. Mellor (exhibit), Crystal of synthetic rutile.
R. B. Farrell (lecture), Goethe's work and its significance in the twentieth century.
E. Ford (lecture), Edward Jenner and vaccination.

H. H. Thorne (lecture), Life and works of Pierre-Simon de Laplace.

L. E. Koch (lecture), On pyrophyllite, its mineralogy, minerogeny and economic prospects in Australia.

October: P. R. Johnson and R. C. L. Bosworth, A new method of measurement of the surface tension of viscous liquids.

F. P. Dwyer and E. C. Gyarfas, The chemistry of ruthenium—VI, The existence of the tris-o,phenanthroline ruthenium II and tris-o,phenanthroline ruthenium III ions in enantiomorphous forms.

F. P. Dwyer and E. C. Gyarfas, The chemistry of ruthenium—VII, The oxidation of d and l tris 2:2′ dipyridyl ruthenium II iodide.

F. P. Dwyer and D. M. Stewart, Complex compounds of aurous halides and aurous cyanide with diphenylmethyl and dimethylphenyl arsine.

H. Wood, Kepler's problem—the parabolic case.

Nora Hinder, Rank variation in vitrain and relations to the physical nature of its carbonized products.

H. Mulhall, The Australian Social Services Contribution and Income Tax Acts, 1949.

R. A. Plowman, Study in the chemistry of platinum complexes—I, Tetrammine platinum (II) fluorides.

N. C. Stevens (lecure), The geology of the Canowindra District, N.S.W.

Royal Society of South Australia

September: R. C. Sprigg, Early Cambrian 'jellyfishes', *Ediacara*, South Australia; Mount John, Kimberley District, W.A.

C. P. Mountford, Gesture language of the Walpari tribe, Central Australia.

October: T. H. Johnston and Nancy G. Muirhead, Larval trematodes from Australian freshwater molluscs.

Royal Society of Victoria

September: G. W. Grigg, Artificial insemination of animals.

October: Eileen E. Fisher, Some sooty moulds collected in Queensland.

G. W. Leeper (lecture), Overseas Soil Research Institutes.

Royal Society of Queensland

September: R. F. Langdon, A new ergot from Queensland.

J. F. Bonner, California Institute of Technology (lecture), Recent adventures in plant physiology.

K. C. Hammer, University of California (lecture), Photoperiodism.

Royal Society of Western Australia

September: A. L. Hagedoorn (lecture), Genetics in its relation to animal and plant breeding.

Mdecial Sciences Club of South Australia

September (held 26 August): Addresses by guest speakers, J. F. Bonner and —. Gregory.

October: D. I. B. Kerr, Vagal influence and the respiratory centre.

J. Stokes, "Q" Fever in South Australia.

Linnean Society of New South Wales

August: W. Boardman, The hair-tracts in marsupials—III.

N. W. G. Macintosh, Crania in the Macleay Museum.

I. A. Watson and W. L. Waterhouse, Australian rust studies—VII, Some recent observations on wheat stem rust in Australia.

A. R. Woodhill, A new subspecies of *Aedes (Stegomyia) scutellaris* Walker (Diptera, Culicidae) from Northern Australia.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

Sandfly Breeding Places

Around many of the tidal estuaries of the New South Wales coast periodic outbreaks of sandflies (Diptera, Ceratopogonidae) can make life exceedingly unpleasant for residents and holiday makers. It has usually been assumed, without any actual proof, that these pest sandflies were breeding somewhere in the mangrove areas frequently associated with these estuaries or coastal lagoons. The lack of precise knowledge, however, of the actual ecological zones inhabited by the young stages of these pests, and also of the actual species involved, has precluded serious considerations of control.

In recent years the writer has had the opportunity of examining collections of sandflies made at times of plague outbreaks, and has also made periodic examinations of an area suspected, on circumstantial evidence only, of being a breeding place for sandflies and ecologically comparable with a number of other notorious sandfly areas.

The very preliminary results of these observations have been interesting. In the first place, the species found to be dominant in actual plagues has usually been a particular, as yet undescribed, species. Several other species do usually comprise a very small percentage of the total invasion and amongst these *Culicoides molestus* Sk. is often present. This particular species has for a long time been considered the dominant biting species of the New South Wales coast, but although it is often recorded biting man it does not appear to assume plague proportions in the type of area at present under investigation.

Secondly, the immature stages of the undescribed species mentioned above have now been found and bred to maturity. This has been from larvae collected in the *Salicornia* zone lying between the mangroves and land, only covered by the highest of spring tides, usually with a fringe of *Casuarina*. Living larvae and pupae are located with difficulty and it is not clear what vertical zone is the actual habitat of these larvae. Cast pupal shells are, however, often found stranded at the fringes of small residual pools in the *Salicornia* zone or may be washed from the moist mud surfaces surrounding such pools.

No evidence of the length of the life cycle of this species, an important point in control considerations, has as yet been gleaned.

DAVID J. LEE.

School of Public Health and
Tropical Medicine,
University of Sydney.
26 July 1949.

Growth of Bacteria in Presence of Peptones

The failure of bacteria to grow in the presence of some types of peptones has been recorded by many workers. We have observed an example of this with strains of *Pasteurella septica*.

Until recently a solution of 1·0% Difco peptone, 1·0% sodium chloride and 1·0% Andrade's indicator was used as a base for carbohydrate fermentation media. Freshly isolated strains of *Pasteurella septica*, however, frequently failed to grow in this medium; but good growth was always obtained in the indole test medium which contained Difco tryptone instead of Difco peptone.

To compare the ability of three different peptones to support growth of the test organisms, three batches of media were prepared, containing Difco peptone, Difco proteose-peptone and Difco tryptone respectively. The carbohydrates used were glucose, maltose, sucrose, lactose and mannitol in concentrations of 1%. Each medium was inoculated with each of eight strains of *Pasteurella septica* and the presence of growth recorded after 24 and 48 hours' incubation at 37° C.

The results are recorded in Table I.

Thus growth occurred in only 25% of the 40 tubes of media containing peptone, in 73% proteose-peptone and in 100% of tryptone medium.

Although the best growth occurred in the tryptone medium, it was noticed that indication of acidity was not as distinct as that obtained in the proteose-peptone medium. Therefore, various combinations of these two peptones were tried. Media were prepared containing tryptone and proteose-peptone in ratios of one part to four parts, two to three, three to two, and four to one. Each of the eight strains of pasteurellae previously used was inoculated into tubes containing each combination. Growth was obtained in all tubes, but the indication of acid production was most definite in the medium containing one part of Difco tryptone to four parts of Difco proteose-peptone.

For identification of freshly isolated strains of *Pasteurella septica*, a medium containing 0·2% Difco tryptone and 0·8% proteose-peptone as the source of nitrogen has proved satisfactory.

We are indebted to R. V. S. Bain, Lecturer in Bacteriology, School of Veterinary Science, University of Sydney, for six of the strains used in these tests.

G. C. SIMMONS.
G. S. COTTEW.

Animal Health Station,
Yeerongpilly, S.4,
Queensland.
7 July 1949.

TABLE I
Number of Tubes Showing Growth

	Difco Peptone		Difco Proteose-peptone		Difco Tryptone	
	24 Hours	48 Hours	24 Hours	48 Hours	24 Hours	48 Hours
Glucose	2	4	5	6	8	8
Maltose	0	0	6	7	8	8
Lactose	1	2	2	4	7	8
Sucrose	1	3	7	7	8	8
Mannitol	1	1	4	5	7	8

Trichostrongylus Infections in the Common Phalanger (Trichosurus Vulpecula)

It was frequently noted that phalangers (*Trichosurus vulpecula*) captured in the Moss Vale district of eastern New South Wales were suffering from diarrhoea on arrival in the laboratory. In some instances the diarrhoea improved. This seemed to be particularly so when the affected animals were fed on leaves from the Moreton Bay Fig Tree (*Ficus macrophylla*).

In other instances the diarrhoea persisted, the possums stopped eating and becamehydrated and marasmic. In this group deaths were common. In one consignment of four animals there were three deaths from this cause within four weeks after arrival. The blood in two fatal cases contained more than five times the normal urea value.

The intestine of a possum which had died from diarrhoea was searched for parasites and a large number (over 5,000) of trichostrongyle worms were found. Two species were present, *Trichostrongylus colubriformis* and *T. rugatus*, the former occurring in an overwhelming majority. Subsequently the faeces of 22 animals, kept in captivity for varying times and not suffering from diarrhoea, were examined

for parasites. Five of these were found to have persistent trichostrongyle infections.

Both of the worms found (*T. colubriformis* and *T. rugatus*) are important parasites of sheep, and it seems that the 'possum and the sheep are able to exchange their trichostrongyle infections with ease.

A. J. BEARUP,
A. BOLLIGER.

School of Public Health and
Tropical Medicine, and
The Gordon Craig Research Laboratory
(Department of Surgery),
University of Sydney.
7 July 1949.

Matching of Binocular Components

The degree of matching of optical components observed in practice by the manufacturers of binocular telescopes has been measured for many of the instruments referred to in a previous communication (Harle, 1948). Properties of particular interest in this respect are the focal lengths of the objectives and the light paths of the prisms. Tables I and II indicate the degree of matching of these properties encountered in a cross-section of instruments of recognized design.

TABLE I
Back Focal Lengths of Objectives

Degree of Matching per Cent.	Percentage of Instruments Examined
0 –0·1	26·9
0·1–0·2	21·5
0·2–0·3	15·4
0·3–0·4	8·5
0·4–0·5	7·7
0·5–0·6	4·6
0·6–0·7	3·8
0·7–0·8	5·4
0·8–1·0	3·1
>1·0	3·1

TABLE II
Light Paths of Prisms

Degree of Matching per Cent.	Percentage of Instruments Examined
0–1	53
1–2	32
2–3	12·2
3–4	1·7
4–5	1·1

G. A. HARLE.

Department of Physics,
University of Sydney.
29 May 1949.

Reference

HARLE, G. A. (1948): This JOURNAL, *11*, 25.

A Simple Device for Controlling Relative Humidity

The scope of many teaching and research laboratories would be considerably enlarged by facilities for controlling the relative humidity (R.H.) of small enclosed spaces. While satisfactory humidity regulators are known, they usually involve expensive and elaborate apparatus (Harper and Wylie, 1946). It is thought that some useful purpose would be served by drawing attention to, and reporting some experience with, a simple and inexpensive device which can control R.H. within limits sufficiently precise for most biological work. No originality is claimed: the apparatus was apparently first described by Wallace and Bushnell (1945) and appears not to be generally known.

The device consists essentially of a container or bag made of cellulose acetate (CeAc) closed by a capillary tube and filled with mercury. A wire is sealed in to make connexion with the main mercury mass, and another is inserted in the capillary. Since CeAc is hygroscopic, expanding with increase in R.H., the operation of the system can readily be pictured. As the R.H. decreases, the bag contracts and mercury is forced up the capillary to make contact with the wire there. This may be made to operate a relay circuit which will activate a humidifier of any type. The R.H. will rise, and the bag relax, till the mercury falls away from the wire in the capillary, so shutting off the humidifier. The sensitivity may be varied by adjusting the relationship between the sizes of capillary and CeAc container. The instrument requires calibration against some standard, and it may be set for a desired R.H. by adjusting either the amount of mercury in the container or the level of the contact wire in the capillary.

The form in which the author has used this device is shown in Figure 1. In order to give some stability to the instrument an open tube *A* of CeAc is sealed to two glass tubes *B* and *C*, of the same diameter. *C* carries a short length of capillary tubing *D* (approximately 1·5 mm. diameter) opening into a cup *E* to hold excess mercury. One contact wire *F* is sealed in through *C*, and the second wire *G* is held from a screw supported by *E*. The lower tube *B* is continued upwards as a long prolongation *H*, leaving only a small annular space *I*. This considerably reduces the amount of mercury required, and also the strain on the CeAc-glass joints, and it has another effect to be referred to later.

The CeAc cylinder was constructed from a discarded film from which the backing and emulsion were removed. The surface was roughened with fine emery cloth to increase sensitivity, and the final thickness was 0·17 mm. In practice it was found advisable to construct the cylinder by winding the sheet of CeAc on a former of glass tubing cut from the same length of tubing as *B* and *C*. A cement

of CeAc in acetone was used and the joints were bound tightly with tape until completely dry. Insecure joints will readily break when the container is filled with mercury.

Such an instrument has been in constant use during the last three years, and has given consistently excellent performance in controlling the humidity of a plant growth chamber of size 6 x 6 x 8 feet. Relative humidities ranged from 75% to 90%, temperature 24° to 25° C. Precise control of R.H. may often be limited by the adequacy of temperature control and the efficiency of humidification. Where these conditions were favourable, the control device maintained humidities to at least ± 1% R.H. over short periods (1 to 3 days) and to ± 2% over long periods (several months). The actual relative humidities were measured by a motor-driven Assmann psychrometer, and also by calibrated mercury-in-steel wet-and-dry-bulb thermometers. The absence of marked drifts, even at such a high R.H. as 90%, contrasts favourably with the well known deficiencies of instruments employing hair as the hygroscopic agent.

The sensitivity of the instrument, in terms of distance of displacement of the mercury in *D* for a given change in R.H., may be calculated

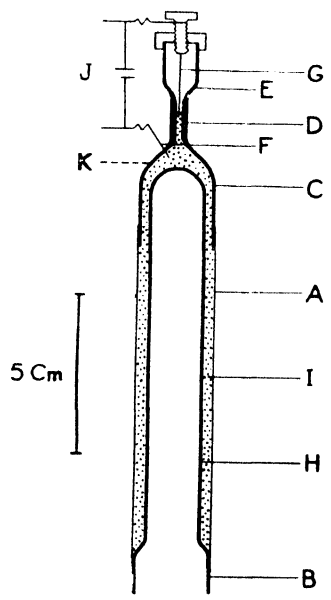

Figure 1.

from the volume of mercury displaced into *E* on removing the bag from a known R.H. to a known lower R.H. For an instrument of the dimensions shown, the sensitivity is almost unnecessarily high—of the order of 8 mm. per 1% R.H.

Two further features require comment. Wallace and Bushnell state 'The humidistat will maintain any particular set for an indefinite period of time irrespective of the intervening humidities to which it is exposed'. Such has not been the author's experience. Irregular variations of 1% to 5% R.H. have been noted on re-equilibrating an instrument to relative humidities of 85% to 90% after sojourns in lower humidities (15% to 70%). To the author this is not so surprising as the smallness of the variations. Even with the CeAc supported on glass tubing, the system is far from rigid, and it is hardly to be expected that on successive occasions the CeAc will assume exactly the same geometric configuration, and hence enclose similar volumes of mercury.

Wallace and Bushnell also state 'The humidistat is nearly linear for temperatures from 15° to 45° C.'. It is not clear whether this is intended to imply that (1) for a given set of the instrument the change in equilibrium R.H. obtained is proportional to change in temperature over the stated range, or (2) the effect of a given change in R.H. is proportional to the temperature obtaining over the stated temperature range.

The author has made no observations relative to the latter alternative, though from the properties of other hygroscopic materials it seems unlikely that this would be so. The former alternative would be expected to be true in so far as the coefficients of expansion of CeAc and mercury were constant over the stated range. Assuming an average value of 1×10^{-4} for the coefficient of linear expansion for CeAc (*Modern Plastics Encyclopedia*), one may calculate for an instrument of the dimensions of, and similar to, Figure 1, but without the inner tube *H*, that a change of 5° C. will produce an alteration of 1·6% R.H. for a given set of the instrument. It is to be noted that the incorporation of glass into the system (with a coefficient of linear expansion only one-tenth to one-twentieth that of CeAc) combined with the consequent reduction in volume of the mercury, operates to increase this value. The corresponding calculation gives a value of 2·7% R.H. for a 5° C. temperature change. This is in good agreement with an observed fall in R.H. from 90% to 88% on raising the temperature from 25° C. to 30° C. Since the instrument requires to be set for each required R.H., this temperature sensitivity is not a severe disadvantage; but if an instrument were required strictly non-sensitive to temperature, it should be feasible to construct one by making the prolongation *H* out of a material with a compensating coefficient of expansion higher than that of CeAc. (Another plastic would do.)

Some defects of the device should be mentioned:

1. It suffers, of course, from all the deficiencies inherent in any on-off type of control.

2. Similarly, it is attended by troubles common to instruments using mercury as a make-and-break mechanism in non-inert atmos-

pheres. Even purified mercury, after some months, will tend to leave 'tails' in the capillary tube. The formation of scum from arcing can be retarded by placing a small condenser *J* across the contacts. The high sensitivity, however, allows the use of a capillary tube of relatively large diameter; this facilitates cleaning when it becomes necessary.

3. The device requires setting against known relative humidities for each combination of conditions required.

It is not claimed that the instrument, as described, is in its most useful form; e.g., different shapes would probably be more sensitive, and the inclusion of a side arm and screw plunger at *K* to make a variable reservoir of mercury would greatly facilitate changing settings.

L. A. T. BALLARD.*

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University of Adelaide.
11 July 1949.

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Paper Chromatography of Some Metals

In previous papers (Lederer, 1948, 1949) the use of butanol saturated with 1N aqueous hydrochloric acid as a solvent in paper chromatography was described for a number of separations. The separation of aluminium from other metals was achieved by several workers by the use of this and other solvents (Arden and coll., 1948; Lacourt and coll., 1949; Osborn and Jewsbury, 1949). In this letter a few additional R_f values are given for butanol saturated with 1N.HCL, which are a continuation of the R_f table published previously (Lederer, 1949). A number of reagents besides H_2S were necessary to reveal most of the metals here examined.

In the table below, the R_f values, colour reactions, and reagents used, are listed for a number of metallic ions. The technique, as previously, is that of Williams and Kirby (1948). By the use of this solvent, trivalent thallium can be separated from all metals except gold and mercury. Beryllium is detected by spraying with ammoniacal solution of quinalizarin, which gives a sensitive blue colour. The R_f value is close to that obtained by Osborn (1949) in a similar solvent. Chromium, however, can not be separated from aluminium, nor indium from beryllium. The rare earths so far examined all give low R_f values, and even after developing some pairs for eleven days no complete separation could be obtained in this solvent.

Zinc can be detected with dithiozone, but the reaction is not reliable, since the filter paper contains copper, which gives the same reaction. The reference line for the R_f values is the border of the aqueous front.

These studies are pursued not only to obtain better separations of complex mixtures, but also because the partition coefficient of an ion is a fundamental property, comparable with the melting point of organic substances; and it is intended to obtain comparative data for all metals. Work with other metals is in progress.

MICHAEL LEDERER.

Chemistry Department,
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4 October 1949.

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Metallic Ion		R_f Value	Reagent	Colour of Spot
Cerium	Ce^{+++}	0·03	Ammoniacal quinalizarin	Blue
Yttrium	Y^{+++}	0·03	Ammoniacal quinalizarin	Blue
Thorium	Th^{++++}	0·03	Ammoniacal alizarin	Blue
Didymium		0·03	Ammoniacal alizarin	Blue
Erbium	Er^{+++}	0·05	Ammoniacal quinalizarin	Blue
Chromium	Cr^{+++}	0·07	Ammoniacal quinalizarin	Red
Aluminium	Al^{+++}	0·07	Ammoniacal alizarin	Red
Magnesium	Mg^{++}	0·11	Azoresorcinol	Blue
Titanium	Ti^{++++}	0·07	Hydrogen peroxide	Yellow
Vanadium	V^{+++++}	0·17	H_2O_2 and H_2SO_4	Red
Beryllium	Be^{++}	0·33	Ammoniacal quinalizarin	Blue
Indium	In^{+++}	0·30	Ammoniacal alizarin	Red
Zinc	Zn^{++}	0·77	Ferrocyanide	White on red
Thallium	Tl^{+}	0·00	Potassium iodide	Yellow
Thallium	Tl^{+++}	1·11	Potassium iodide	Brown

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Views

The National University

There have been in recent years numerous theoretical attempts to plan science. They range in scope from Bernal's 'The Social Function of Science' to Dr. Worrall's discussion during the A.N.Z.A.A.S. meeting at Hobart in January, 1949 (This JOURNAL, *11*, 197). What is not so generally realized is that we have just seen the result of one attempt to plan science and are at present witnessing the culmination of yet another attempt. The attempt of Adolf Hitler failed as miserably as did the attempt by the Pope of Rome in 1633. Hitler planned his science on the assumption that Nordic (or Aryan) science was all that mattered. By this blunder he lost the war. In Soviet Russia science is planned along two lines. First, it must conform, outwardly at least, to orthodox Communist creed. This means that any radically new departure such as relativity, quantum mechanics or the chromosome theory of heredity is automatically suspect. The least harmful result of this type of planning is a delay in the scientific effort, whilst such 'fundamental' questions are being decided. We of the Western World should be thankful that the battle against this type of planning was won for us by Galileo and T. H. Huxley.

The second line along which Soviet Science is planned is the 'humanitarian' line, advocated so strongly by Dr. Worrall. There is no doubt that Marshal Stalin and Trofim Denisovitch Lysenko (1949) are filled with 'humanitarian ambitions' which are 'deep and overwhelming'. Lysenko is filled with the righteous aim to make two blades of grass grow where none grew before, for the ultimate benefit and glory of the Russian proletariat. Marshal Stalin is ready to help all he can. He provides the necessary adjuncts to such planning—the scurrilous ballyhoo in *Pravda*, the concentration camps, etc., for those Russian scientists who exercise their Galilean right to criticize any statement by means of that scientific technique which we have inherited and learnt from Roger Bacon, Cranmer, Oliver Cromwell and Karl Marx.

It is, of course, unlikely that any planning of science in Australia would lead to such disastrous results: but it is always as well to realize that planning in some countries and at certain times has led to results diametrically opposite to those the sincere planners may have desired. There is, however, a widespread feeling of uneasiness among Australian scientists about the very foundations of their research and University organizations. This feeling was aptly expressed by Professor Ward at the recent discussion on 'The Place of the National University' during the recent A.N.Z.A.A.S. meeting. The same disquiet is shown in Professor Matheson's (1949) discussion of 'Engineering Research in Australia'. (This JOURNAL, *11*, 194, 1949). There are several reasons for this feeling of uneasiness. As Sir John Medley points out, the value of research is already appreciated in its defence and medical and agricultural aspects. He maintains quite correctly that research is also an educational necessity. The trouble with such omnibus words as 'education' is that they have so many meanings. In this modern world, before any research can be done, our political leaders have to be convinced of the supreme importance of research. Education for a politician probably means something very different from what it does for so experienced an educationist as Sir John. We scientists and other research workers have to emphasize that research satisfies one of the vital functions—call it intellectual, aesthetic or what you will of the human spirit. This may be a difficult idea to get across to a hard-headed politician. But from its flow all the benefits of applied science, and there can be little real hope for Australian Universities and Research until this idea is got across.

That this dominating idea is still completely unappreciated is shown well enough by the terms under which the National University is set up. To begin with, it will contain only schools of Medicine, Physical Science, Social Science and Pacific Studies (which last two are, I presume, of recent American origin but of doubtful parentage). The attitude seems to be: 'Away with all such useless occupations as the study of Greek, systematic botany, philosophy or chromosomes!'.

Now Australasia has produced one supremely great research worker—the late Lord Rutherford. The requirements for his 'dilettante' work, when he began it, were few. He required the association of kindred 'useless' minds—minds interested simply in knowledge for its own sake. His apparatus he made out of string and sealing wax and bits of metal and glass tubing. He had to leave Australasia to find even these few things. It may be that surfing and sheep farming are incompatible, for reasons at present unknown to our 'social scientists', with the highest exercise of the human intellect. I do not think so. But we have to face the fact that, thanks to the efforts of our sincere planners, the National University is set on a course which can only be described as that of applied science. We academic

scientists can have no quarrel with any increase in the quality and quantity of applied science in Australia. It is needed. But it will be a major tragedy if the keystone of our national *academic* structure, our National University, becomes a University of Technology.

H. N. BARBER.

University of Tasmania,
October 1949.

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Scientists and Publicity

I have been invited to comment on a letter, appearing in This JOURNAL, *12* (1949), 35, the subject of which seems to me of vital importance to all people. The rate of development in science, and in the technological processes which follow, are so far ahead of human adaptation to the changes brought about by them that we are ruled by our environment, not rulers of it. It is the duty of scientists to minimize the lag between advances in knowledge and public appreciation of the significance of such advances to our lives.

Two aspects of the Science Association's letter appear to need comment: the organization of the publicity services and their scope.

With regard to the former of these, I quite agree with the criticisms made. While not excusing the shortcomings at Hobart, it must be pointed out that this was the first Congress for which a Publicity Officer had been appointed. This was some advance on arrangements at previous Congresses where reports were issued by the General Secretary or just left to chance. Right from the start of the Hobart Congress it was apparent that publicity services should have been highly organized, from the points of view of both the Press and the Association. The Press wanted news and more news: the Association couldn't cope with their demands chiefly because there was not the organization within the Congress to provide the news. On the other hand, because Press staffs were non-scientists in general, appreciation of fundamental problems was restricted and the news tended to deal with details rather than with general issues. In a report to the Association last April on publicity services at the Hobart Congress I suggested that these difficulties might be resolved by (a) creating the office of Honorary Publicity Secretary in the Association, (b) inviting the Press to appoint an officer with scientific qualifications to assist the Honorary Publicity Secretary at Congresses, and (c) arranging publicity channels within the Congress organization to provide information about its proceedings.

The other matter of importance is the scope of publicity services for science. I suggest that such publicity should be continuous, not just given attention at the time of Congresses. The work of increasing public awareness of the results of science should go on all the time and the appointment of a Publicity Secretary would provide a channel between science and the community.

N. J. B. PLOMLEY,
Press Liaison Officer,
Hobart Science Congress.

Queen Victoria Museum,
Launceston.
August 1949.

Reviews

Agriculture

CORN AND CORN GROWING. Fifth edition. By Henry A. Wallace and Earl N. Bressman. (New York: John Wiley; London: Chapman and Hall. 424 pp., 64 text-figs., photos and maps, 46 tables. 5½″ × 8″.) Price, $4.50.

This new edition deals with the history of corn as far as is known from its mysterious origin to the present day varieties and hybrids. A chapter is devoted to the importance of corn, which, coupled with a very fine chapter on corn products and their uses, gives a good overall picture of the value of corn to the world. Corn breeding is adequately covered and includes sections on hybrid corn development, giving clear definitions of each step in the procedure. A chapter on corn genetics bolsters up the study of corn breeding, but may have been better placed to precede the chapter on breeding. A short chapter is devoted to the classification of corn. A useful chapter includes the germination and food requirements of the corn plant; it is followed by a series of chapters which deal with cultivation, from preparation of land to harvesting, embodying such problems as weed control, insect pests and their control. (Black Beetle is not mentioned.)

Whole chapters are given to Pop corn and Waxy corn; further chapters to cost of production, marketing and community problems which are mainly of American application but which give food for thought in the further development of corn in Australia. Of particular interest is the extent to which Hybrid Corn has grown in America. In 1933, 0·1 per cent. of the total average in U.S.A. was sown with Hybrid seed, in 1947 it had risen to 71·4 per cent.

The book could well find a place in the libraries of Universities, Agricultural Colleges and Schools as a book for supplementary reading. The chapters devoted to breeding, genetics, culture and uses would be of value under Australian conditions. A well selected glossary of terms is given, and a wide range

of corn statistics. The book is well and clearly written and the type is good. Illustrations are apt and well defined.

J. O. Smith.

The Potato. By W. G. Burton. (London: Chapman and Hall, 1948. 319 pp., 25 text-figs., 57 tables, $8\frac{1}{2}'' \times 5\frac{1}{2}''$.) English price, £1. 5*s*.

Dr. Burton has brought together the results of researchers, diffused through the literature, of physiological studies on the yield and composition of the potato. The subject is approached from the viewpoint of a plant pathologist.

Two chapters deal briefly with the origin and history of introduction of the potato into the British Isles, and the potato varieties grown there. The varieties more commonly grown in Australia (Factor, Up-to-Date, Brownell, Bismark and Carmen, and the new varieties Katahdin, Sebago) are considered only in later chapters. Of the ten chapters, four are concerned with factors influencing yield and composition. These treat, firstly, the effect of climate, length of growing season and soil type; then, manuring; then, effects of diseases and pests upon yield; and finally, variety of potato, source and characteristics of seed and spacing.

Following chapters deal with distribution and composition of the dry matter in the tuber; nutritive value; cooking quality; and storage. Appendices include the uses of the potato other than for human consumption; and specific gravity as a guide to the content of dry matter and of starch.

There are good photomicrographs of pith and raw tuber, cells of cortex and pith in fully cooked tubers, and spray-dried mashed potato powder. A figure showing the underground parts of a potato plant morphology would have been greatly enhanced if it had been a photograph instead of a line drawing.

The book is essentially for reference, and as such will be useful to agronomists and food technologists, as well as to dietitians.

N. H. White.

Anthropology

Man in the Primitive World. An Introduction to Anthropology. By E. A. Hoebel. (New York: McGraw-Hill, 1949. 543 + xii pp., 73 text-figs. and photos.) Price, $5.00.

Professor Hoebel has produced a much needed introduction to Anthropology. This book really is suitable for students *beginning* their University courses in the subject, and for specialists in other fields who desire a general account of the scope and subject matter of Anthropology. It is up to date—a feature of some significance in the parts dealing briefly but soundly with human origins, fossil man, the stone ages and 'race and culture'. The largest part of the book provides an adequate introduction to the study of primitive society, concerning such general topics as Subsistence and Crafts, Marriage and Kin, Status and Social Role, Property, Social Control and Religion. The reader is made familiar in an interesting manner with the terms used in, and with the concepts and problems of, Social Anthropology. Reference is also made to some of the important theories and controversies, in suitable contexts.

There are several specially good sections, such as those on Housing and Art, and on the Family and Marriage. The author's themes that marriage makes the world safe for the family, and that social order and promiscuity do not mix, are important from the functional point of view.

The final part of the book, 'Society and Culture', pp. 425-494, is an exception to its general 'first-year' character. The problems of 'Society and Culture', of 'Culture-Areas', of 'Personality and Culture', of 'Invention and Diffusion' and of 'Cultural Evolution' are more advanced. In any case, they are rightly put at the end of the book, and so can be studied when required.

In commending this book as an introductory text-book, to be used along with lectures, one does not vouch for its accuracy in all details. A writer covering such a wide field in scope and content, and moving over most of the face of the earth, is apt to slip in generalizing about customs and institutions of particular peoples in whose cultures he has not specialized. The reviewer could point out several examples of what appear to be inaccurate or unsatisfactory statements and generalizations with regard to the Australian Aborigines, and is doing so in *Oceania* (Vol. 20, No. 2); but these can easily be corrected by the lecturer, and are only a slight blemish on a most valuable and commendable introductory text-book.

A. P. Elkin.

Biochemistry

Manual of Practical Biochemistry, for Medical Students. By Mark L. Mitchell. (Adelaide: The Hassell Press, 1949. 181 pp. $5\frac{1}{2}'' \times 8\frac{1}{2}''$).

This book is divided into two sections: Part 1 on Qualitative Analysis and Part 2 on Quantitative Analysis. The expressed intention of the author is to provide a suitable manual for use by medical students studying biochemistry at the University of Adelaide. This has been accomplished and more. The contents display material suitable for students of other faculties (including Science) where instruction in fundamental physiological chemistry is needed.

The methods are supplemented by notes (in small type) on principles and points of technique. The text is preceded by general laboratory instructions which, although commonplace, are invaluable in the conduct of any laboratory; if followed, the work of the students and demonstrators is considerably lightened and much more valuable.

It is felt that the distinction between *cc.* and *ml.* which the author makes (page 4) should have been logically developed or not used at all; formulae for simple compounds could have been used throughout in place of the inconsistency of giving the formulae in some cases (H_2SO_4), writing out the name in full (sodium hydroxide) or writing an abbreviation (pot. ferricyanide). Further, the use of alternate blank pages for the recording of qualitative results (page 3) is an invitation to the student to neglect the proper use of a practical notebook, which must be regarded as an integral part of any practical work, whether quantitative or qualitative.

The work covered in the text includes that generally regarded as necessary to give a knowledge of the properties and quantitative determination of compounds of clinical interest. Professor Mitchell has succeeded in producing an attractively set-out book which can be highly recommended to all students of biochemistry.

GEORGE HUMPHREY.

Botany

LE BOUTURAGE ET LES SUBSTANCES DE CROISSANCE SYNTHETIQUES. By E. J. B. Verleyen. (Antwerp: University of Belgium, 1948. 214 pp., 85 tables, 37 plates. $8\frac{1}{2}'' \times 11''$, paper covers). 1,000 copies, for private distribution.

In this publication Dr. Verleyen, Director of the Botanical Garden of Antwerp, gives a very detailed record of his researches on the mode of action and the employment of plant-growth regulators in the propagation by cuttings of species and varieties of conifer, chrysanthemum and other horticultural plants. Special consideration is given to indoleacetic acid and naphthaleneacetic acid, and the experiments cover about 30,000 cuttings. The report on his own investigations is preceded by a critical examination of previous work on the origin of adventitious roots and the use of synthetic growth substances in the rooting of cuttings. An excellent bibliography is included, as well as a detailed summary in seven European languages.

Dr. Verleyen concludes that, in the present stage of knowledge, only hypothesis can be put forward, to explain the manner of action of growth substances in inducing root formation; and that a very marked improvement can be obtained in the rooting of horticultural plants by the use of plant-growth regulators, particularly by stronger dosing of the cuttings for a lesser time than hitherto recommended by other investigators. There are, however, differences in the results obtained from one species to another, and even from one variety to another, which clearly show the important influence of internal factors, irrespective of the decisive influence of external conditions such as source of cuttings and propagation methods.

C. J. MAGEE.

Chemistry

PROGRÈS RÉCENTS DE LA CHROMATOGRAPHIE. Première Partie: Chimie Organique et Biologique. First edition. By Edgar Lederer. (Paris: Hermann et Cie, 1949. 146 pp., 19 text-figs. $6\frac{1}{2}'' \times 10''$.)

In this book Dr. Lederer reviews the literature on chromatography of the last ten years. The text includes contributions up to September 1948, but important papers published up to April 1949 are added to the relevant chapters in footnotes.

The more recent advances of the European schools are very well discussed, especially the work of Claesson and Tiselius, which receives only short mention in other monographs on this subject. Relatively short chapters are devoted to new apparatus and modifications of Tswett's technique. The chapter on adsorbants discusses fully the methods for the standardization of adsorbants.

The main portion of the book constitutes the chapter on novel applications of chromatography. This is discussed in relation to the compounds chromatographed. Seventeen headings deal with almost any type of compound. Partition chromatography both in columns and on paper is included in each section; amongst the figures in the text are photographs of paper chromatograms and of the apparatus used for paper chromatography at the Institute de Biologie Physico-Chimique. An interesting chapter is devoted to secondary reactions between the adsorbent and the adsorbed compound. The book concludes with a short biography of Michel Tswett, the inventor of chromatography.

This book is not only of great value to the chemist with a reading knowledge of French: even without the knowledge of this language it is invaluable as a literature survey consisting of 538 references. By referring to it the research worker in any part of organic and biochemistry is able to obtain a summary of the applications of chromatography in his particular field.

MICHAEL LEDERER.

RECENT ADVANCES IN ORGANIC CHEMISTRY. Volume 3. Seventh edition. By A. W. Stewart and H. Graham. (387 pp., text-figs., 2 plates. $4\frac{1}{2}'' \times 7''$.) English price, £3. 3*s*.

The growth of organic chemistry continues at such an increasing rate that one is apt to feel overwhelmed by the enormous volume of published material. Short up-to-date accounts of selected topics are therefore of inestimable value, and the appearance of this volume of a well known and standard work will be welcomed by many and will scarcely need commendation. Because of the many important advances, the edition has been rearranged as Volumes 2 and 3; Volume 1, which can no longer be regarded as dealing with recent advances, being now out of print.

The volume maintains the standards set by previous editions. Much new material has been added and several new chapters incorporated. The scope may be gauged by the following list of chapters: The Bile Acids and Sterols; Vitamins; The Hormones; The Cardiac Aglycones; Some Natural Porphyrins; The Azaporphyrins; Synthetic High Polymers; Rubber; Some Deutero-Organic Compounds; ·Isomerism in Cyclic Compounds; The Diphenyl Problem; Some Aspects of Stereochemistry; New Organo-Alkali Compounds; Cases of Abnormal Valency; Structural Formulae and their Failings; Some Applications of Electronics to Organic Chemistry and Some Unsolved Problems. In addition, there are appendices on the synthesis of vitamin *A* and of folic acid. The subjects are discussed in an easy, readable style and the more important references are cited. Graphical formulae are frequently used and the index appears to be adequate.

E. Ritchie.

Coal

Technology of the Fischer-Tropsch Process. By B. H. Weil and J. C. Lane. (London: Constable, 1949. 248 pp., 19 text-figs., 24 tables. 5½″ × 8½″.) English price, 22*s*. 6*d*.

The authors have provided an urgently needed text-book on a highly scientific and specialized industrial process, which is undergoing rapid development because of shortages and dwindling resources of natural petroleum. The future demands for liquid fuel must be met, at least in part, by synthetic production from raw materials of which there are very large reserves. The Fischer-Tropsch process, which consists essentially of catalytic hydrogenation and polymerization of carbon monoxide, is as yet the most promising process for production of synthetic liquid fuels. It also offers, through aromatization, a means of large-scale production of almost any organic compound, from 'coal, water and air'.

A great deal of research and industrial development has been carried out on all aspects of the Fischer-Tropsch process. Previously, the results of this work could be found only in individual papers and specialized contributions. With the publication of *The Technology of the Fischer-Tropsch Process* a general text-book becomes available, dealing adequately and comprehensively with all of its diverse aspects. The authors deal also with the present situation regarding liquid-fuel resources, and with the economy of the process. They give valuable appendices of Fischer-Tropsch patents, and a general bibliography.

In addition to providing a source of essential data and specialized information for those actively engaged in research on the Fischer-Tropsch process and its industrial applications, the book serves as an excellent introduction to the technology of synthetic petroleum.

J. A. Dulhunty.

Genetics

Dictionary of Genetics. By R. L. Knight. (Waltham, Mass.: Chronica Botanica; Melbourne: N. H. Seward, 1948. 183 pp. 6″ × 9″.) Price, $4.50.

The terminology in any rapidly developing basic science is bound to undergo many confusing changes. Old words are continually being more accurately defined and new words are being coined to describe new or better-understood phenomena. In genetics as well as in other biological sciences the non-specialist can sometimes justly claim that all these changes appear to have made confusion worse confounded. There is, thus, a need for the production of glossaries and dictionaries defining terms used in special branches of science.

Dr. Knight's book performs these functions in a competent way for genetics, defining over 2,500 terms. There are, however, two points which seem to require some clarification. The first is the method of selection of terms to be defined. For example, it may be interesting to know that 'equilenin' is 'a hormone found in the urine of pregnant mares', but the genetical significance of this piece of information is not immediately apparent. Whilst there is no doubt that genetics is contributing to the solution of many biochemical problems, it is doubtful whether it is necessary to devote so much attention to the partial definition of sex-hormones, vitamins, etc., in this dictionary. Incidentally the definition of hormone given is incorrect in two respects.

The second point is that dictionaries such as Knight's could be expected to play an important part in the standardization of terminology. This could be done by indicating which terms are obsolete or obsolescent. Such terms as 'cytodiaeresis' and 'karyokinesis' (for mitosis) may, indeed, be of interest to the student of the morbid anatomy of language, but it seems hardly necessary to define such antique monstrosities and scarcely to indicate they are obsolete. It is, perhaps, too much to expect one man to attempt such adjudication in many cases of synonymous terms. It will be interesting to see what the recent International Congress of Genetics has made of these problems in its discussions on terminology in Genetics.

H. N. Barber.

Nuclear Physics

Radioactive Measurements with Nuclear Emulsions. By Herman Yagoda. (New York: John Wiley, 1949. 356 pp., 75 text-figs., bibliography, 6″ × 9″.) Price, $5.00.

Few devices have been more fruitful in the development of science in nearly all its branches than the photographic plate. It is difficult to imagine how, for example, spectroscopy, astronomy, or X-ray crystal structure analysis would have fared without its aid. That the potentialities of the photographic plate are still far from being exhausted is clearly evident from this book.

A fine-grained, thick-layered emulsion, carrying much silver bromide and but little gelatin, is in many respects equivalent to a Wilson cloud chamber in its ability to distinguish between the tracks of densely ionizing particles. 'It permits the differentiation of the tracks produced by mesons, protons, tritons, deuterons, α-particles and fission fragments. . . . The simple measurement of track length permits an accurate measure of particle energy.' Because such an emulsion may be immensely useful in the study of the mechanism of nuclear reactions, it is called a 'nuclear emulsion'. This is, however, not its only field of application. It may also be used in the autoradiography of minerals, metals, crystals, and plant and animal tissues containing radioactive tracer atoms.

Dr. Yagoda sets out 'to describe, co-ordinate and define the limitations of this simple method of instrumentation'—a task which he has done notably well. The book will interest not only nuclear physicists and radiochemists, but investigators in the field of mineralogy, crystallography, biology and metallurgy. Special attention is given to both α- and β-ray autoradiography. The whole work is very fully documented, containing some 700 references.

To anyone either setting out to use, or merely interested in the use of, photographic emulsion to study the phenomena of radioactivity, this book will be invaluable. Printing and illustrations are extremely well done.

D. P. MELLOR.

Book Notices

THE PRACTICE OF SOIL CONSERVATION IN THE BRITISH COLONIAL EMPIRE. By Sir Harold A. Tempany. (Commonwealth Bureau of Soil Science, Technical Communication No. 45, 1949. 106 pp., many text-figures and photos. Obtainable from C.A.B. Liaison Officer, 314 Albert St., East Melbourne, C.2.) Price, 12*s*. 6*d*.

This is the first detailed account of the progress of soil conservation and erosion control in the British Colonies as a whole. The author has had wide experience both in the Colonial Office and in different colonies. He has been in communication with the Directors of Agriculture in the territories dealt with, and has thus included up-to-date material from unpublished records, and from published sources not easily accessible.

He remarks that there is 'growing realization that conservation measures should not be regarded as separate ends in themselves, but must be integrated into systems of husbandry capable of maintaining and enhancing soil fertility'. To a great extent the future of many of the colonies depends on how successfully they solve problems of erosion.

GROWTH SUBSTANCES AND THEIR PRACTICAL IMPORTANCE IN HORTICULTURE. By H. L. Pearse. (Commonwealth Bureau of Horticulture and Plantation Crops, Technical Communication No. 20, 1948. 233 pp. Obtainable from C.A.B. Liaison Officer, 314 Albert St., East Melbourne, C.2.) Price, 15*s*. 8*d*.

The information on the use of plant hormones, which was previously published by Pearse as T.C. No. 12, has been brought up to date in this review. It deals adequately with the history of the new developments. The use of growth substances in vegetative propagation is covered in detail, and is strengthened by the inclusion of an index of seventy-eight pages listing typical results obtained with cuttings of various species. Sections are devoted to the treatment of seed and seedlings, and the treatment of growing plants. The use of growth-substances in inducing parthenocarpic development of fruits is dealt with at length. The interesting results obtained with tomatoes and other fruiting plants are described, with notes on other aspects of such treatments. The chapter on the use of growth substances as selective weed-killers is of particular interest to Australian agriculturalists generally. Questions of the prevention of sprout development in potatoes, and the retardation of flowering to escape frost injury, are dealt with comprehensively. The text is supported by a comprehensive bibliography.

BASIC ELECTRICAL ENGINEERING. By George F. Corcoran. (New York: John Wiley and Sons; London: Chapman and Hall, 1949. 449 pp., numerous text figs. 6″ × 9″.) Price, \$4.50.

The name of this book is misleading, as it hardly scratches the skin of electrical engineering. It is, rather, a treatise on the principles of applied physics which form the basis of electrical engineering. It has a liberal supply of numerical examples, and might well be read by students who intend to embark on an engineering course.

A NOTE ON THE POLAR DIAGRAMS OF LONG WIRE AND HORIZONTAL RHOMBIC AERIALS. D.S.I.R., Radio Research Special Report No. 16. (London: H.M.S.O., 1948.) Price, 9*d*.

Calculation of the polar diagrams of long-wire or rhombic aerials has been made from time to time in particular cases and is a long and laborious task. This note presents a simple theory of long-wire and rhombic aerials in such a manner that the physical principles involved may be readily understood and the results applied to special or new systems. From the appropriate polar diagram obtained, an accurate polar diagram can then be derived at critical points (e.g., maxima and minima) by considering second-order effects. Design charts for this purpose are included.

The methods described may easily be applied to other types of long-wire aerial and linear arrays, and are particularly useful for calculation coverage areas for E or F region reflections in the ionosphere.

INVESTIGATIONS OF HUMAN REQUIREMENTS FOR B-COMPLEX VITAMINS. By M. K. Horwitt, E. Liebert, O. Kreisler, and Phyllis Wittman. (Washington, D.C.: Bulletin of the National Research Council, No. 116, 1948. 106 pp., 10″ × 7″.) Price, \$1.00.

The bulletin deals mainly with the effects of variation of intake of B-complex vitamins in the diet of mental patients. Evidence of the ill effects of thiamin deficiency were conclusive, but there was no indication that generous allowances were of any value in treatment. Evidence with regard to other members of the B-complex was inconclusive. The summary and general conclusions are contributed by R. D. Williams, E. S. G. Barron, G. Elvehjem, and M. K. Horwitt.

RECOMMENDED DIETARY ALLOWANCES, Revised 1948. U.S.A. Food and Nutrition Board. (Washington, D.C.: National Research Council Reprint and Circular Series No. 129, October 1948. 31 pp., 10″ × 7″.) Price, \$0.25.

One the whole, the recommendations of the Board have not been changed except for a slight increase for calcium (to 1·0 gm. per day per man). The discussion of the recommended values has been extended and brought up to date. Representative meals containing the recommended allowances are now included, and a further list of references is given.

The Australian Journal of Science

Vol. 12 21 December 1949 No. 3

Evolution in Action*

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It is an old gibe that evolution and particularly natural selection have never been observed in action. Until a few years ago the palaeontologist could give the most detailed picture of evolution in certain exceptionally well preserved groups of organisms. The classical work on the Ammonites with the gradually increasing complexity of the shape of the shell and the sutural folds, followed by a return to the simple type and the final extinction, seems to many people the best and most direct evidence for evolution. Or again, the gradual development of the horse's hoof through *Eohippus*, *Mesohippus* and all the other fossil hippos seems a much clearer and more vivid demonstration and proof of evolution than even those of Charles Darwin.

This sort of work, important as it is, remained, until a few years ago, essentially a picture-book story of evolution. What moves the picture had remained, so far as the palaeontologist was concerned, as mysterious as ever. In fact, the grand sweep portrayed in these historical studies has made many workers fall back on a Bergsonian '*élan vitale*', 'orthogenesis' or other useless entelechies. Any sort of mechanism seems too crude to explain the nicety of adaptation, or the beauty and tragedy of the stories of past evolution in action.

This emotional reaction is by no means limited to palaeontologists. It is shown by many excellent biologists whose fields of work lead them to study the contrivances by which orchids are pollinated, or by which spiders catch their prey, or by which the wonderfully varied collection of animals survives under almost any stone of a rocky seashore. How can such infinite diversity have been derived by an almost blind natural selection acting on completely blind mutation? Far better to follow George Bernard Shaw and Marshal Stalin and postulate a purposive Lamarckian adaptation process.

The same problem is at the root of many of the political ills in this one world of ours. Herr Hitler believed he could control human evolution. His methods were those of a ruthless stockbreeder. He decided on his ideal type and aimed to exterminate the rest. Marshal Stalin also believes he knows the answer. As Rousseau wrote in 1754, 'man is naturally good and only by institutions is he made bad'; so the Communists believe that man in a socialist society would be the perfect communist, and this formula, judging by the remarks of Lysenko (1949) and Marshal Stalin, is the all-powerful formula for directing human evolution by the controlled change of human heredity. No intractable genes can resist this Soviet indoctrination. If they do, there is always the concentration camp in the last resort. The British and the Americans, as might have been guessed, are, on the other hand, hardly conscious that there is a problem. For Americans the problem was solved by Thomas Jefferson's immortal words in 1776: 'We hold these truths to be self-evident, that all men are created equal. . . .'. The British view is aptly summarized by Bertrand Russell in his recent broadcast talks, the Reith lectures. He is prepared to assume that man's inherent genetic make-up has not changed appreciably since *Homo sapiens* arose a quarter of a million years ago. In any case we cannot do much about controlling our biological evolution, so why bother our heads about it.

We know, however, that several thousand human chromosomes were changed in Japan in an almost irreversible way on 6 August 1945. We know that certain human genes, even without the aid of high energy radiations, are changing at definite small but measurable rates. We know that most of these changes, whether artificially induced or not, are deleterious to the human machine in many different ways. The changes can cause such minor maladies as inability to taste phenylthio-urea, or they may interrupt the metabolism of phenylpyruvic acid and quite incidentally stop us thinking at all, or they may lead to a gross inequality between the sexes, as, for example, in haemophilia. Instability of the hereditary material of the chromosomes can do all these important things. The real problem is: What has been the result of these changes since Genghis Khan swept across Asia, or since Rameses reigned on the Nile, or since the first Aurignacian hunter killed his first mammoth? Scarcely stagnation, one would suppose; and, although some of the Tories among us would have us so believe, scarcely a continuous degeneration from some Golden Age, whether that age be Aurignacian, Neolithic, Grecian or Victorian. More important, what will be the result of these changes after a few more generations of human evolution? Can we in

* *Evolution*. Published quarterly by the Society for the Study of Evolution, Prince and Lemon Sts., Lancaster, Pa., U.S.A., and the Chicago Natural History Museum, Chicago 5, Ill., U.S.A. Subscription for non-members of the Society, $6.00 a year, payable to Lancaster or Chicago. Editorial communications to be sent to the Editor, at the American Museum of Natural History, New York 24, U.S.A. Volume *1* commenced in March 1947.

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any sense predict and thus learn to control human evolution?

A direct answer to these problems is not possible at present. But the answer today seems much closer than it did even five years ago. This change has come about not through an appeal to authority, even though that authority be as high as Karl Marx's (or Marshal Stalin's), but by patient experimentation and observation which, as in the best traditions of Western Civilization, has been unhampered by any serious religious or political persecutions. It has, however, been difficult for the average worker in the field of evolution to keep track of all the reflections from the numerous facets of his problems. His problems have been dealt with in a wide variety of scientific journals ranging from the *Journal of Bacteriology* to the *Journal of Palaeontology* and *Journal of Genetics*. Now it is one of the triumphs of modern genetics that a discovery in bacteria or *Drosophila* can throw light on what is happening in *Plantago* or what happened to *Pithecanthropus*. If we can understand evolution in the fly, we shall most probably understand it in man and in ammonites. There is, thus, a need for a journal which can cover this wide variety of topics and thus make comparisons easier and also show us the gaps in our knowledge. These functions the new journal, *Evolution*, published by the American Society for the Study of Evolution and edited by Dr. Ernst Mayr of the American Museum of Natural History, performs in a manner which at first leaves one gasping. The first six numbers contain papers on Drosophila (13), other insects (bees, bugs, and beetles, etc.; 5), palaeontology (invertebrate and vertebrate; 6), human evolution (1), birds (4), fishes and frogs (one each), hybridization in sages, sunflowers and oaks (one each), as well as more general papers such as Mayr's closely argued paper on 'Ecological Factors in Speciation', or Anderson's short and snappy, 'Hybridization of the Habitat', and an excellent review by Axelrod on the climates of the Middle Pliocene.

Reading these papers, it is impossible not to be struck by the unexpected and, therefore, important relationships which spring to mind by the juxtaposition (to choose almost at random) of the Reeds' paper on 'Morphological Differences and Problems of Speciation in *Drosophila*', and Stebbins *et al.* on 'Hybridization in a Population of *Quercus marilandica* and *Q. ilicifolia*'; or of Weidenreich's 'Trend in Human Evolution' and Dobzhansky's 'Adaptive Changes Induced by Natural Selection in Wild Populations of *Drosophila*', or Lack's beautiful analysis of 'Natural Selection and Family Size in the Starling'.

Let us try to see how these comparisons will revolutionize the whole of biology from medicine and anthropology to systematic botany. For example, every taxonomist in our herbaria and museums should read the fascinating story of the technical and morphological delimitation of species in *Drosophila*. The classical example is the two forms *D. psuedo-obscura* and *D. persimilis*. They were formerly called *D. pseudo-obscura* race A and race B, and shown by genetic methods to be almost sexually incompatible and to give an almost sterile hybrid. In nature, hybridization has never been observed. Ten years ago, the species could be separated only by using the senses of the males of the two species, which are more acute than ours. It was then discovered that the wing beat frequency was different in the two. This led to a detailed examination of wing structure, and it was soon shown that the two could be almost completely identified by 'Reeds' wing index', (area of wing)^2/(length of wing)^3, an index chosen on aerodynamical considerations. Now, by a series of counts of the numbers of teeth in the sex combs, it has been possible to increase our efficiency in identifying the two. In other words, the probability of misclassifying a single dead fly has been reduced from about a half to something under one in a hundred or one in a thousand.

It is, of course, impossible to grow Eucalypts as rapidly or under the standard conditions under which it is possible to grow *Drosophila*. These technical factors have undoubtedly simplified the Reeds' careful work. But it is possible to measure the variation in natural populations of Eucalypts, and thus end the state of uneasy compromise which has existed in Eucalypt taxonomy since the publication of Blakely's synopsis of the genus in 1934. For example, Anderson (1947) in discussing the stringybarks says: 'The various species are not easily separated from each other, and the botany of the group is difficult to follow except by specialists'. The way is now clear for a final attack on this problem. It will, of course, lead to the specialist ceasing to be a specialist.

Other methods for the analysis of the same problems are given in Stebbins's paper, or Epling's on *Salvia*. Such careful work of Epling's leads immediately to a morphological classification, but it does much more. It enables him to discuss the general problem of speciation in plant populations, all members of which have the *same chromosome number*. He also comes to the interesting conclusion that plant species may retain their ability to cross because of the advantage gained by the extra plasticity conferred on both by the resulting gene leakage. The main barrier between the species may be a slight ecological preference. This discussion immediately raises the question of the origin of the species. This question is also discussed by Mayr, who concludes that 'sympatric speciation, if it occurs at all, must be an exceptional process'. In other words, some large scale geographical isolation is necessary before the development of two species out of what was originally one genetically-continuous population. The operative words are 'large scale'. In fact, the problem might be better discussed by asking the

following question: What sizes of populations and what rates of gene migration, between any two originally infraspecific populations, are compatible with ultimate speciation? Whilst Mayr's arguments are good, to a botanist they are hardly convincing as yet. One reason for this is his failure to discuss allopolyploidy in detail in this context. One of the conditions of allopolyploidy is, of course, sympatry with both parental species. Since between a quarter and three-quarters of Angiosperm species are allopolyploid, sympatric speciation must be important in plants. But even leaving this complication on one side, it is difficult to assume that such closely related *Eucalyptus* species as *obliqua*, *fastigata*, *regnans*, *sieberiana*, *consideniana*, *gigantea*, etc., all have arisen geographically isolated one from another. Their characteristic ecological pattern of zonation with altitude is difficult enough to explain without the added complication of assuming extensive migrations from different ancestral homes. In any case, an equally important problem is whether the Canberra Hills are sufficiently 'geographically' isolated from the Coastal Ranges to have permitted the differentiation of *fastigata* inland, and *obliqua* on the Coastal Ranges.

The most important papers are, however, those of Dobzhansky on evolution in action. His demonstration that natural selection can bring about *seasonal* evolutionary changes in *Drosophila pesudo-obscura*, like Dubinin's parallel demonstration that the destruction of Voronesh by the Germans was sufficient to alter the evolutionary history of the *Drosophila* living there (quoted by Lysenko, *et al.*, 1949), have the most far-reaching consequences, not only in the evolution of man in his increasingly complex societies, but also in the natural history of malaria, poliomyelitis, eucalypts and kangaroos. The amazing delicacy of natural selection in picking out gene complexes which can be identified only because they are conveniently (and significantly) associated with different gene arrangements (inversions), should make every doctor pause before prescribing penicillin for some trivial skin complaint, which might yield almost as easily to bathing in boracic acid. We know enough of the adaptive mechanisms in bacteria (Luria, 1947) and fungi to be able confidently to assert that the widespread and indiscriminate use of such powerful weapons against disease will lead to their becoming blunted and useless. We cannot assume that bacterial evolution in response to changes in environment will not be at least as rapid as that in a fruit fly. Neither can we assume that it will be less reversible.

There remain the immense problems presented by the palaeontological story of human and plant and animal evolution. One welcomes the acts of faith of Wood in his study of the palaeontology of rodents and Colbert in his study of Dinosaurian evolution; but it is clear that much more work will be necessary on the experimentally controllable evolution of organisms still alive on this earth, before these very general genetic interpretations of palaeontological fact become really useful, by enabling us to predict what the evolutionary story has been before we dig it up. Weidenreich's paper, like Sir Arthur Keith's recent book (1948), is useful in presenting these problems in the most spectacular manner. Weidenreich would like to believe in an Osbornian orthogenesis, Keith in a militaristic Golden Age, as having directed and controlled human evolution. The one sure fact is that all the old theories of human evolution, whether they be Christian or Communist, anthropological or archaeological, will have to be recast in the light of our increasing knowledge of evolution in action. Today the important thing to realize is that the correct methodology for the study of such problems has been worked out. There are many ways. The accurate study of the mutation rates of human genes, in which any general practitioner or obstetrician can assist, is one way (Haldane, 1948). The detailed study of the linkage relationships of the Rh genes is another way (Mollison, *et al.*, 1948). The correlation of phonetics with the frequency of the blood group genes is another method (Darlington, 1947). The detailed study of the effect of change in mating systems is yet another method (Dahlberg, 1948). For example, it is commonly assumed that the increase in mean stature which has occurred in the populations of Western European origin is due almost entirely to better living and food supplies. But how much has the randomization of human mating systems consequent on better communications and larger communities been also effective in increasing stature? As Haldane has pointed out, the village 'bus service may have had a more profound eugenic effect than all the efforts of our professional eugenists. Finally, one cannot help comparing the effect of mild etherization as described by Streisinger, on the mating reactions of *Drosophila*, with the action of alcohol in both primitive and civilized human communities. Human societies from the Hindu to the Irish and aboriginal Australian are riddled with mating taboos. The effects of such taboos on human evolution have hardly been investigated. But at least a prima facie case could be made out that too strict an endogamous mating and caste system leads to an evolutionary stagnation. If this be true, 'the abominable rites practised in India' such as sakti-puja described so long ago by the Abbé Dubois (1816), or 'the uses of wives . . . considered by us to be objectionable' among the Australian aboriginals (Elkin, 1948), or even the Lancashire Wakes Week, may take on a new significance.

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Science in the Future of Papua and New Guinea

J. K. MURRAY*

An address given at the Inaugural Meeting of the Scientific Society of New Guinea.

IT is a cause for pleasure and of more confident regard for the Future, that there is a Scientific Society established in the Territory of Papua-New Guinea. To the maxims 'no foot, no horse', 'no water, no farm', we can add 'no science, no progress'. What do we mean by 'the Future', as it applies to the Territory? What it may mean to us and what it can mean to native peoples will not coincide. What the future will mean eventually to the native population will, in a basic way, be consequential on the contributions science makes to that future. In terms of years, for the purpose of the present discussion, 'the Future' may be taken as matter of something like half a century. If we, a people endowed with the resources of western civilization, fail to accomplish great and significant development in half a century, we will have exhausted the time which we can reasonably expect to be available.

A period of more than sixty years of 'European' administrations of the Territory has already passed by, and yet native young people educationally equipped to study sciences in an Australian university are not available. When we note that fact, and then affirm that half a century is an alloted time in which to have Papuan people and New Guinea people with educational, agricultural, medical, engineering, general science, and art qualifications, with effective mass-education behind, we do not underestimate the difficulties to be surmounted. A phrase of significance is that 'it may be later than we think'.

In 1949 we cannot afford to take things nonchalantly, letting the decades slip by, in the hope that somebody somewhere is accomplishing for the Territory the things, in terms of scientific effort, which expeditious overall development of its people and of its biological and physical resources necessitate. What we must have in mind is what can be accomplished in half a century, say by A.D. 2000. The accepted task before us is first, native welfare—the social, economic and political development of the native people; and, equally and concurrently, the economic development of the Territory using conservational techniques. The Japanese accomplishment in the fifty years after 1868 is not without point, though the analogy should not be pushed too far.

Now, if this task means what it says, and Australia means to compass it, we are in the Territory to serve that purpose, whatever our individual rôles may be. The task imperatively calls for 'European' contributions. To get the essential western technological methods widely adopted in the country, there must be 'European' guidance. What there has been of agricultural industries and of mining industry has been dominantly a consequence of 'European' guidance and control. The policy of the Commonwealth Government towards the Territory includes efficient participation by European people in its development. The policy also involves that the mode in which the European contribution is made shall, when the development of the native peoples approximately catches up with ours, permit of the native people still owning their country. One will thus appreciate why land leases are now generally for a period not longer than 50 years. From A.D. 2000 on, land lease should come in for re-allotment in accordance with the political needs of the day. Implicit in the situation is confidence that arrangements made in the future will be equitable. We do not accept that the integrity—the intellectual integrity—of the middle centuries, or of any previous period in human life, was generally of as high a standard as now.

Scientific effort should be bent towards giving a balanced development of people and of resources. Whatever political set-up there may be in fifty years, we trust that it will not be obscurantist. With the opportunities increasingly presented by science, the human race should increasingly solve its problems in felicitous ways.

In discussing the rôle of the sciences, we note that there is diversity in their exactitude. We can claim, with due timidity, 'exact' sciences in astronomy, physics and mathematics. They possess degrees of exactitude in which we have placed almost implicit trust. In some fields, somewhat momentous in solution of our peculiar problem, the degree of exactitude, though increasing, is less high; for instance, in the important fields of psychology and anthropology. Those less exact sciences have their critical and increasing contribution to make in social and political development, and human society is giving these studies increasing attention and increasing support. Native administration, a prime

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responsibility of the Administration, has basic tasks for anthropologists; our present lack of adequate anthropological knowledge has come about from a lack of appreciation of essential requirements in the administration of dependent peoples.

With regard to the Territory generally, a paramount and pressing concern will be an assessment of the Territory's potentialities. Consider one instance of what a portion of that problem means. Some of the personnel of the British Food Mission flew over certain areas of the Territory; they were quite confident that the potentialities were important, to solve the food situation in Great Britain. The outcome of the discussions was that the Australian Government, in respect of some projects, undertook to put £50,000 into a potentiality survey, and to provide several of the scientists. The British Food Mission, not being plenipotentiary, were of the opinion that the United Kingdom Government also would provide £50,000 and a number of the scientists required. In spite of its importance to us and to Great Britain, the project fell through: but note the figures. We need to make an assessment of the potentialities of the Territory, not only to meet the requirements of Great Britain, but as an essential prerequisite to the planning in a detailed way of the development of this Territory and of its people. One small survey was recently carried out—a nutritional survey covering some of the food patterns; this involved the services of several scientists for months.

We do not think of potentialities purely in a sense of physical resources. What are the potentialities of the people of the Territory? Possibly some still think that a coloured, native person of the Pacific is of a lesser mental calibre (in terms of innate intelligence) than people such as the general run of Europeans. We have learned, of course, that there is no reason for considering that a cross-section of the people of Papua-New Guinea is any less intelligent than a cross-section of the people from, say, Eire to the toe of Italy. There may be different aptitudes: the northern and southern Italians, the French peoples, the English, the Welsh, the Irish, and the Scots seem to illustrate that. There is no sound ground, then, for saying that the people of Papua and New Guinea, the so-called 'Stone Age people' are any less *intelligent* than we are. What we do know is that the difference between such dependent people and ourselves is primarily a difference of opportunity, and part of our accepted task is to provide an environment in which adequate provision is made for native welfare and the development of the native people. Science can play its great part in ensuring that the human asset as well as other resources is adequately developed.

The Government needs economic development to obtain locally the finances required for essential services and, eventually, for responsible government. The development of the physical resources must effect, in a many-sided way, the development of the people of the Territory; but the reverse is immensely true too. In the overall development there are the complementary factors — the conservational development of the physical resources by related applied sciences, and concurrent social and economic development of the people themselves. Fundamental, then, to the development of the people and the Territory, is the contribution science can make in the accurate assessment and humanist conservation of its potentialities — human, animal, plant and physical.

Some remarkable efforts are being made on the physical side. No project, perhaps, has been more suitably provided for or more scientifically approached than the Australasian Petroleum Company's investigations for oil prospects in the Territory. Along other lines, however, there is room for great effort. Up to the time of the cessation of Civil Government in Papua, in 1942, there was not a Department of Agriculture—after nearly sixty years. In the Territory of New Guinea there was such a department, but it was greatly limited by insufficient funds. Neither territory had a Department of Education, although the problem of education in a population exceeding one million people was a most obvious and difficult responsibility.

Possessing technical knowledge, moreover, is not enough. To facilitate a great accomplishment we must also have some medium of expression which teachers and learners both understand. The solution of this problem involves the use of a *lingua franca* with a rich cultural and technological literature; and the whole gamut of education, including such aids as the best use of broadcasting, educational recordings and visual methods in the social development of a million illiterate people.

Among the applied sciences, medicine can make an immense contribution to the Territory, requiring a great financial commitment. Just over the way is Queensland with a population roughly about the same as that of the Territory. In addition to its governmental, professionally-staffed Health Department, it has all the private and corporate activity in related spheres. To develop something comparable in the Territory is an immense task. In a part of the Sepik District, the infant mortality rate is 500 per 1,000; in Australia it is round about 30 per 1,000. The problem of infant mortality presents both opportunity and a great and complex task for the medical and other sciences. International relations being such as they are, increase in the native population may be a factor in its survival and in our security.

Regarding another of the applied sciences, agriculture, we see shifting agriculture at its worst—the *reductio ad absurdum* of rotation. This must be replaced. Both native people

and Europeans squander a soil, in a generation or two, that has taken at least all the 6,000 years of civilization to form; and then they either move on, or want to move on, destroying more. Soil conservation and crop management in this tropical area are in their irresponsible infancy, when compared with the corresponding techniques of the United Kingdom, north-west Europe and parts of China. We must conserve the soils; increasing their fertility, not depleting it. Insufficient thought is given to old-established industries; for instance, the betterment of production from the coconut palm, in which it is often taken for granted that the type of coconut and the present mode of handling its production are, practically, the ultimate solution. Through agricultural science, plantations old and projected should produce greater income without a proportionate increase in outgo. There are, likewise, rubber plantations producing less than 500 pounds of rubber per acre. In Malaya and some other countries, plant breeders and geneticists have produced commercial rubber clones having a productivity of 1,000 to 1,500 pounds of rubber per acre. We can increase, and are increasing, our future production and efficiency by selected plant material. Scientists of the Department of Agriculture in New Guinea have improved planting material like cocoa, in which European people are interested, and in which the native people must become, and are becoming, interested; and they have improved native foodstuff crops and advocated techniques which would conserve or lift soil fertility levels. Human nutritional problems are serious; health, agricultural and educational services need to work together.

There is a reasonable prospect of the potentialities of the Territory being developed by us, and by the native people themselves, provided that we can succeed in a relatively short time in developing its potentialities, biological and physical. 'It may be later than you think', and, in looking at our task and its problem, one must stress again the axiom that the difference intellectually between the native people and ourselves has been a matter, not of differences in innate intelligence, but of opportunities, presented to us by our community and our civilization and not yet made available to them.

A factor affecting 'Science in the Future of the Territory' is the important difference between the pre-war situation and the present situation. History neither repeats itself with any exactitude nor would we bring repetition if we could. In the immediate pre-war years the Australian Territory of Papua received about £40,000 to £50,000 a year as a Grant-in-Aid from the Commonwealth Government. The Mandated Territory of New Guinea did not receive a grant. The combined territories are now receiving a Grant-in-Aid amounting to about £3,000,000 a year. When one speaks of Science's contribution, in the future, to the development of territorial potentialities (of peoples and of things) and affirms that a great achievement ought to be accomplished in fifty years, the 1945-49 attitude of the Commonwealth Government gives confidence that such an achievement will be realizable.

People in Australia are working on a plan for the Territory in which science in the broadest sense will share fully in the rational development of its resources. We remember well the Russian five-year plans. It might be better to plan here in terms of seven years, or something of that sort; in detail for the first period, and in less and less detail beyond. It would require up to seven years before cocoa, coffee, rubber, tea, copra, fibre, or beef projects came into considerable production. Some animal projects (pigs, sheep, goats) and crop projects (such as rice and tobacco) may require less time. Just what science generally, and the applied sciences in particular, may do in relation to potentialities of the Territory, is largely governed by what Australia does in the integration of the economy of the Territory with that of Australia. There are other possible, but nationally questionable, solutions. An assured market, with stabilized prices for certain primary products, such as rubber, copra, cocoa, coffee, tea, fibres, spices—what you will, in tropical production—up to the capacity of the Australian and territorial markets to absorb, would provide a basis on which the progressive economic development of the native people and the Territory can be scientifically arranged, and its own internal financing ultimately brought about. Most secondary industries will be, as they were in Australia, later developments.

Not only is the country able to produce the tropical ingredient in the Commonwealth economy, but it is able to produce, if the Commonwealth plans to use it, hydro-electric power at a cheaper rate, and in much greater quantities, than the Australian possibilities. Fifteen million horsepower are said to be available from hydro-electric sources. A high degree of dependability of supply throughout the years can be assured by the use of grids tapping both the south-east and north-west dominated rainfall areas, each of which is served by annual rainfalls of 70 to over 250 inches. The Kiewa Hydro-Electric Project, in Victoria, will produce round about 250,000 horsepower at a capital of about £28,000,000. A plant at Rouna Falls, of approximately the same power, is estimated to cost £3,000,000. Supposing that there were an understatement, increasing the Rouna Falls estimate by 100 per cent.: such amended capital cost (£6,000,000) is round about one-fourth of the cost for a similarly-sized project in Australia. With the 'atomic' age upon us, the water-power resources of the Territory look increasingly important. The Germans got their heavy hydrogen from Norway: the cheap power, hydro-electric power, was there. Many industrial developments in Norway depend on cheapness of power; assuredly they will here also.

Just what are the aluminium industry possibilities have not been investigated. If iron ore can be transported from Yampi Sound, W.A., to Newcastle, N.S.W., maybe bauxite could be brought to New Guinea's power, if suitable supplies of it are not in quantity in the Territory. With a marked nitrogen response in the tropical agriculture of Queensland and New Guinea, production of cheap combined nitrogen in the Territory looks more economic and wise than importation of it from sources outside the Commonwealth.

In some century we may synthesize commercially all the proteins, just as we have succeeded in the synthesis or production of minor proteins, some fats, carbohydrates, vitamins, rubber, indigo, quinine, etc. Some developments of applied sciences may make and utilize food and clothing constituents so efficiently that the beef-producing, milk-producing and fibre-producing animals will be interesting exhibits in international gardens. But the day is not yet! When it does come, the power available from hydro-electric sources in the Territory may be figuring as a factor of world importance in production, and the problems of soil utilization and conservation will have become less pressing that they are in our underfed and underclothed world.

New Guinea lies off the eastern Australian coast much like Norway and Sweden in relation to the United Kingdom, and has the Norwegian strategic and power potentials. The cheap hydro-electric power potential is, perhaps, the most striking feature in the whole of the Territorial economy. The only existing hydro-electric plants, other than the upper and lower Baiune plants of B.G.D., are small ones put in by missions—which have the vision this way also! In Port Moresby we produce current from crude oil at about 4*d*. a unit; yet we have ample hydro-electric resources within 25 or 30 miles. A small scheme of about 2,500 horsepower can be put in at Rouna Falls for under £200,000, and produce current at under a penny a unit; we hope to see it in 1952. There was once a suggestion to take the water of the Fly River across to Queensland and irrigate part of Queensland with that immense amount of water. It seems less fantastic to suggest the future development of immense quantities of current at low costs in the Territory and the making of it available in Australia; the problem of cheap transfer of current from Papua to Queensland may not continue to be an insoluble problem for engineering science.

With regard to precious metals in the Territory, a high level of efficiency has been achieved by engineering science in the obtaining of gold in the Wau-Bulolo area. One may stress the point with regard to hydro-electric resources again, by saying that the Bulolo-Wau dredging procedures simply could not be undertaken were it not that power can be produced for a fraction of a penny per unit.

With regard to the Australian School of Pacific Administration, there are precedents in other colonies. The Dutch educate people, who enter their District Services, in universities for periods of up to five years; the British Colonial Service takes degreed men and gives them post-graduate courses at universities on colonial administration broadly considered. The *opportunities* for science to function will be determined very largely by the calibre of the staff of the School of Pacific Administration (or institution of similar function); of the Civil Service and Civil Service departments; and of the District Officers (Resident Commissioners, elsewhere). In a scientific approach to the development of the Territory, there are important organizations that will make a great contribution. The School of Pacific Studies of the National University will be a national component of the greatest significance. The South Pacific Commission has a Research Council of distinguished men scientifically interested in native administration and production in the Pacific. The Research Council will do important work in relation to the Territory for two reasons. The first is that about half the population—the dependent population—of the South Pacific are in this Territory; the second reason is that, although six metropolitan powers make up tne South Pacific Commission, Australia provides 30 per cent. of the finance.

The Commonwealth Scientific and Industrial Research Organization is spending over a million pounds a year on scientific research for the Commonwealth; but, up to the present, not one of its six or seven divisions is located north of Sydney. It has devoted its attention primarily to southern Australia, where the bulk of the population is. It appears nationally unwise that the C.S.I.R.O. should devote disproportionate attention to the problems of the Papua-New Guinea Territory, the problems of Queensland, and those of the Northern Territory and the northern half of Western Australia. At some stage it will orient, markedly, its work more towards the tropical and subtropical problems of the Commonwealth than has been the case up to the present; the tendency is apparent now.

To summarize: We are honourably developing programmes related to our accepted obligations in respect of the native welfare, the social and political development of the native people. We are lagging in the economic development of the native people and of the Territory's resources. Every phase of the development of the people and of the Territory depends for speed and efficiency on scientific method, and on the adequate functioning of science in the future of the Territory.

Eventual responsible government and early self-dependency in substantial measure critically depend on a great and broad scientific contribution in research and the adequate application of research to teaching and development in their manifold phases. We must have that contribution made by A.D. 2000, only fifty years ahead.

Recent Progress in the Classification and Mapping of Soils and Soil Resources in Australia*

J. A. PRESCOTT AND J. K. TAYLOR

I. INTRODUCTION

CONSIDERABLE advances have occurred in the classification and mapping of the soils of Australia and the determination of soil resources, since a statement was presented to the meeting of the Pan-Pacific Science Congress in 1939. Progress, slowed materially by war-time requirements in other directions, has been accelerated since 1945, particularly due to the viewpoint adopted in surveying and the need for developing land settlement areas for servicemen. The development of techniques in field work and mapping has enabled the reconnaissance of considerable areas to be both more exact pedologically and more informative in regard to land utilization.

The development of soil conservation authorities in all States except Tasmania, where the hazard is relatively small, has pushed forward the mapping and estimation of erosion, and the study of its control. Classification systems have been devised and used successfully. For the purpose of ensuring co-ordination of policy and action among the States, a Standing Committee on Soil Conservation was set up in 1946, consisting of the heads of soil conservation bodies in the six States and three representatives of the Commonwealth. The Committee meets annually for its review and mutual exchange of information. The Soil Conservation Service of New South Wales has, since 1945, published its own journal, with articles on subjects such as advances in field practice and accounts of projects in erosion control.

Soil resources in the undeveloped portions of inland and northern Australia have been further investigated in the course of extensive reconnaissances by the Commonwealth North Australia Regional Survey group in the Northern Territory, by the Queensland Bureau of Investigation in south-western Queensland, and by the Western Australian Department of Agriculture in the Kimberley Region of north-west Australia.

The increased use of aerial photographs has been a significant advance by State and Commonwealth bodies concerned with soil and agricultural resources. The great bulk of soil and erosion surveys in recent years has been made with this aid.

The aggregate area of soil surveys in Australia has now reached a total of about 178,000 square miles, as set out in Table I.

* This report was compiled as the result of a request for a statement to the Standing Committee on Soil Survey and Classification of the Pan-Pacific Science Association. It was presented at the Christchurch, N.Z., session of the Conference on 17 February 1949 by J. K. Taylor.

Table I.
Soil Surveys in Australia to 1948: total area, in square miles.

Detailed	*Broad Scale*	*Reconnaissance*	*Total*
2,500	5,500	170,000	178,000

II. CLASSIFICATION AND MAPPING OF SOILS

(a) *Zonal Soil Groups*

A new soil map of Australia involving a complete revision of the data and classification of the 1931 map was published in 1944 (Prescott, 1944). The eighteen zonal groups now defined afford a much clearer picture of the nature of Australian soils in comparison with the international Great Soil Groups. The proportional occurrence of the new groups is given in Table II.

Table II.
Major Soil Groups of Australia.

	Area in Sq. Miles	*% of Total*
1. Tablelands and Ranges ..	415,352	14·0
2. Desert Sandhills	391,915	13·2
3. Stony Deserts	168,228	5·7
4. Desert Loams	542,278	18·3
5. Desert Sandplains	159,412	5·3
6. Brown Soils of Light Texture	151,755	5·1
7. Grey and Brown Soils of Heavy Texture	271,024	9·1
8. Solonized Brown Soils (Mallee Soils)	164,053	5·5
9. Mallee Sandhills	19,723	0·7
10. Solonetz Soils	19,027	0·6
11. Red Loams	6,032	0·2
12. Red Brown Earths and Terra Rossas	122,748	4·1
13. Rendzinas and Black Earths	118,340	4·0
14. Podsols	247,586	8·3
15. Residual Podsols and Lateritic Sandplain	122,285	4·1
16. Low Country Subject to Periodical Flooding	24,828	0·8
17. Tidal Marshes and Deltaic Formations	22,740	0·8
18. High Moor	7,194	0·2
Total Area: 2,974,520 square miles.		

A soil map of the major soil zones of Western Australia was published in 1938 (Teakle, 1938) with a classification based partly on the 1931 soil map of Australia, but using also climatic and vegetational associations, allied with a soil characteristic, e.g., 'red and brown acidic soils of the acacia semi-desert scrub-mulga, etc.'. Nine zones were defined and mapped approximately. This work made use of the concept of broad 'soil regions' as units of mapping.

The factors responsible for the genesis of soils have also received increasing attention. The soil categories recognized in the general soil map of Australia are to be divided into three major groupings—the desert formations associated with an absence of leaching, and the pedocals and pedalfers of Marbut. The outstanding problems in this connexion involve the study of the factors responsible for land forms in the desert regions, the study of mutual relationships between the black earths

and the rendzinas, the better understanding of the pedogenesis of soils associated with calcareous parent materials such as the rendzinas and the terra rossas, and the place of the Australian red-brown earths in a world system of classification.

The categories of podsolic types need also to be more clearly defined and there is already a recognition of grey-brown podsolic soils, meadow podsols and humus podsols, although it has not yet proved possible to map these on any continental scale.

Of special importance also has been a developing interest in problems of pedogenesis particularly in the cases of soils showing evidence of the influence of former climatic conditions differing from those existing at present, a subject conveniently designated as palaeopedology. Progress has been made in interpreting the catenary relationships of soils derived from the dissection of laterite (Stephens, 1947) which is now generally recognized as having been formed in Pliocene times (Bryan, 1946; Crocker, 1946; Whitehouse, 1940).

Of special interest also has proved to be the investigation of the influence of Post-Miocene climatic and geological changes on the genesis of South Australian soils and in particular the suggestion that the calcium carbonate present in the 'Mallee' soils is a loessial accession (Crocker, 1946).

There is scope for geochemical investigations as an aid to the understanding of the problems of genesis and fertility in the major soil groups. Some detailed work has already been done on the heavy mineral assemblages in sand fractions, especially from Western Australian soils (Carroll, 1938; see earlier work by the same author). A start has already been made with the identification of the clay minerals of at least one Australian soil group —again the Mallee soils.

(b) *Technique and Progress in Broad Scale Surveying*

Soil classification has been constantly under review. In common with other countries engaged in soil survey, Australian workers have had to examine critically the units used for mapping, and define them more specifically. All units, beginning with the soil type and proceeding to higher categories up to the Great Soil Groups, have been considered. The greatest aid to progress in surveying has come from the definition of the soil association and soil combination as mapping units. The soil association is a group of soil types, not necessarily inter-related, occurring regularly in a recognizable pattern over extensive areas. A soil combination is a group of soil associations used as a larger mapping unit.

The technique of surveying adopted for broad groups is to select, first, typical portions within the project area representative of differences in parent material, topography, drainage and vegetation, and to survey these in detail. The practice has been to deal with units between 5,000 and 10,000 acres in extent and by judicious selection of locations cover in full detail up to 5 per cent. of the gross area in this way. This enables the constitution of associations to be worked out soundly, and thereafter large expanses of country conforming to the pattern can be surveyed rapidly, using traverses one or two miles apart and mapping with the aid of aerial photographs. Considerable mapping has gone forward on these lines in several States, by the Division of Soils, Council for Scientific and Industrial Research.

Classification on a broad scale using generalized soil groups has been carried out on one or more areas in Queensland by the Bureau of Investigation (Q.B.I., 1944-45-46). The groupings have been of the nature of 'sandy soils', 'black and volcanic soils', 'alluvium', etc., and undoubtedly provide a base for further mapping; they should be associated with future detailed and association surveys on selected portions.

The necessity for reconnaissance of very large stretches of country in North Australia called for a different attack, as there are few roads and passability to motor transport is restricted. The resultant grouping decided on for mapping was a 'land system' defined as 'a region throughout which a recurring pattern of soils, vegetation and topography can be recognized'. No boundaries of soil types, associations, or similar categories were mapped, due to the scale of working; but the land systems were noted as containing definite catenas or other soil families, within each of which occurred a range of members or subgroups. The survey named these constituents of the catenas and families; it now remains to follow up the broad work with suitable mapping of boundaries of these groups, and then proceed to the detailed study of those portions deemed worthy of closer investigation. All the work so far has been based on the consideration of the geology, topography, vegetation and drainage of the country, as indicative of the soils proved by the survey to be allied to various combinations of them. Aerial photographs have been used over the major part of the surveyed area (Christian and Stewart, 1947; Stewart, 1947).

In a different category come some large scale reconnaissances in which the soil factor is secondary to other land-use characteristics. Some of this type of work has been undertaken by State authorities, such as the investigations by Irrigation Commissions concerning potential irrigation development, or surveys by the Queensland Bureau of Investigation over scantily settled areas.

A summary of broad-scale surveys carried out since 1938 is given in Table III; these figures exclude the land-use surveys mentioned in the previous paragraph.

Table III.
Broad Scale Soil Surveys in Australia, 1939-48; total areas, in square miles.

Broad Scale Surveys	*Reconnaissance Surveys*	*Total*
2,920	158,250	161,170

(c) *Soil Erosion*

Erosion investigations have steadily grown in extent and improved in quality. The Rural Reconstruction Commission, set up by the Commonwealth Government to enquire into aspects of rural development in Australia, issued in 1945 a report, 'Land Utilization and Farm Settlement', in which the incidence of erosion in Australia was summarized, with maps showing approximate areas with various types of erosion-hazard. Generalized maps of this type focus attention on the broad problem, but specific investigations are essential to assess its significance. A book has been published on 'Soil Erosion in Australia and New Zealand' (Holmes, 1946), giving an account of the state of erosion and of some measures practically applied, and discussing the problem as to cause and trend in different environments in Australia.

Surveys involving classification and mapping of erosion have gone forward both as detailed and reconnaissance forms. In 1941 the New South Wales Soil Conservation Service undertook an overall survey of the erosion status in the eastern and central portions of that State (Kaleski, 1945). The Service drew up its own schedule, defining erosion in eight classes, which comprise two of gully erosion, two of combined gully and sheet erosion, one of sheet erosion, two of wind erosion, and one of no appreciable erosion. Boundaries were mapped as accurately as the scale permitted, particularly on the severely damaged areas, which formed 1 per cent. of the total, and were deemed beyond economic reclamation. Eight land classes based on topography and vegetation were distinguished, to separate arable and grazing land each in two slope classes, timbered lands in two topographic classes, mountain grazing and State forests. The survey covered 98 counties, aggregating 184,805 square miles, with an estimated accuracy in mapping of the erosion status within 2 per cent. by area.

Some of the most valuable lands in south-eastern Queensland, particularly the Darling Downs, have been severely damaged by sheet and gully erosion. The Queensland Bureau of Investigation has prepared maps of this and certain other parts of the State, such as the South Burnett district (Q.B.I., 1946). Other States have made progress, but maps and data have not yet been published.

Detailed mapping and study of soil erosion has been carried out by the Division of Soils, C.S.I.R., over four units in Victoria and South Australia, aggregating 1,245 square miles of detail and 2,150 square miles of reconnaissance. A schedule for mapping erosion was devised by the Division of Soils (Taylor and Stephens, 1943), and, with sundry small modifications, has been applied successfully to diverse sets of conditions. The objective of these surveys has been to examine closely and to map a unit sufficiently large as to be practical, and to represent the soil condition over much larger stretches of country. Thus the survey in Co. Moira, Victoria, was marked by a peculiar form of erosion described as tunnelling (Downes, 1946) which has shown up subsequently more widely; at Coleraine, Victoria, there were serious land slips and gullying. A large project in South Australia has dealt with areas marginal for arable agriculture, which, due to long cropping under a too low and erratic rainfall, has suffered severely by water and wind action. A considerable volume of material is now awaiting publication.

(d) *Detailed Soil Surveys*

Detailed surveys using standard technique have continued since 1938; reduced to a minimum from 1942-45, but subsequently greatly accelerated. The bulk of the work has been carried out by the Division of Soils, Council for Scientific and Industrial Research, but contributions have also been made by the Department of Agriculture, Victoria (Skene and Friedman, 1944), the University of Melbourne (Holmes, 1940; Goudie, 1941), and the Department of Agriculture, Western Australia (Teakle and Southern, 1938; Teakle, 1947). The scale of mapping has varied, according to the intensity of land use, from 10 to 20 chains to an inch; most of the surveys on irrigation areas and soil erosion mapping are on this scale. Aerial photographs are regarded as essential, and the field recording is done on the photographs, from which co-ordinated plans are compiled.

A feature of detailed survey work has been its application to soils used for engineering and building purposes. The classification of types based on specific characteristics has been studied, such as structure of certain profile horizons, as this character affects water absorption and expansion of clays, which touches on stability of building foundations. Surveys and soil studies over an area of 4,000 acres in the cities of Melbourne and Adelaide have been made to this end (data awaiting publication).

Progress in the years 1939-48 inclusive is shown in Table IV.

Table IV.
Detailed Soil Surveys in Australia, 1939-1948.

Irrigation Areas		*Rainfall Areas*
Horticultural	*Grazing*	
76,000 acres	1,132,000 acres	100,000 acres

(e) *Structure and Texture Classifications*

A good deal of attention has been paid to the structure of the soil horizons as a critical feature in their description and classification.

Attempts have been made to define the nature, size, hardness and consistency of aggregates as significant details in identification of soil series, and the field observation has been accompanied by preliminary trials of laboratory tests. The difficulty of dealing under field conditions with soils at varying moisture contents, and hence varying characteristics of the aggregates, can only be resolved, apart from an acquired judgment, by parallel mechanical tests in the laboratory. This matter is under investigation by the C.S.I.R. Division of Soils. The problem of structure is connected with the erodibility characteristic of soils.

The C.S.I.R. has studied mechanical analysis of soils in relation to field textures (Marshall, 1947). Textural groups have been defined as approximate portions of the texture triangle, in terms of sand, silt and clay (international size limits), and in a new diagram relating clay to the median size of the non-clay fraction, by which account is taken of the fineness or coarseness of the sand fraction.

(f) *Trace Element Deficiencies*

An increasing volume of work has been done in Australia on the relationship of specific soil groups to deficiencies in elements essential for plant growth. It is probable that retardation of agricultural development of the better-rainfall country in Australia has been due to such deficiency. This, and the low phosphate content often associated with soils in the zones with over 25 inches annual rainfall, has resulted in extensive areas in coastal and sub-coastal regions remaining undeveloped. Some soil surveys have been inspired by deficiency problems, e.g., in the Cressy-Longford district, Tasmania (Stephens, *et al.*, 1942), where the key lay with molybdenum.

Investigations have shown problems of deficiency, or toxicity, of copper, zinc, manganese, boron, molybdenum and cobalt in a number of areas. Copper deficiency appears to be the most widespread, particularly in Western Australia and South Australia. The impoverished podsolized soils in south-western Western Australia, associated with laterite formations, frequently respond to copper, and recent studies in South Australia (Riceman, 1948) have confirmed the lack of both copper and zinc, and sometimes molybdenum also, in the south-eastern portions of the State. These may be factors affecting productivity over even wider areas though with less spectacular evidence. Excess or lack of manganese and molybdenum are showing up as causative factors in abnormal growth and diseases of crop plants, and some recent investigations have pointed to the mechanism of these effects (Leeper, 1947).

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Psysico-Chemical Symbols

THE following report was composed by the Commission on Symbols, Units and Nomenclature established by the International Union of Pure and Applied Physics and was approved by the General Assembly of the Union held at Amsterdam in July 1948 (This JOURNAL, *11*, 199-200).*

The recommendations of the report were approved as recommendations, not as final decisions, and are accordingly published below for general information.

Note: In general no special attention is paid to the name of the physical quantity.

Physical quantities should be printed in *italic* type: (Q, v).

Units, mathematical operations and dimensions should be printed in small Roman type: (cm, s, dS, exp at, grad V, sin x, [$\mathrm{l^2t^{-1}m}$]).

These symbols are not followed by a full stop.

Exceptions:

(1) i or j, $=\sqrt{-1}$.

(2) Symbols for units derived from proper names should be printed in CAPITAL ROMAN type: (V, A, kV, mA). Symbols for prefix mega, giga and tera are printed in CAPITAL ROMAN type: M, G, T.

Numbers should be printed with upright figures. A comma or point may only be used to separate whole numbers from the decimals. To facilitate the reading of large numbers the figures may be grouped together in groups of three but no comma or point should be used.

Chemical elements should be printed in Roman type. The attached numerals should have the meaning:

mass number .... $^{14}_{7}\mathrm{N}_2$ .... atoms/mol.
atomic number ....

Symbols for Units

UNIT	SYMBOL
metre	m
centimetre	cm
micron	μ
metre cube	$\mathrm{m^3}$
litre	l
second	s
hour	h
hertz	Hz
gram	g
ton	t
dyne	dyn
newton	N
bar	b
poise	P
erg	erg
joule	J
watt	W
calorie	cal
degree Centigrade	°C
degree Kelvin	°K
lumen	lm
lux	lx
stilb	sb
candle	cd
coulomb	C
ampère	A
volt	V
ohm	Ω
farad	F
henry	H

* The recommendations on the use of symbols for units, for physical quantities, and for mathematical constants and operations, contained in this report are in general in agreement with a number of important international and national recommendations, viz.:

1. I.S.A. Bulletin 30 (International Federation of National Standardising Associations).
2. Report of the Joint Committee of the Chemical Society, the Faraday Society and the Physical Society of England, together with the International Union of Chemistry on Symbols for thermodynamical and physico-chemical quantities (1947).
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Prefixes for Units

PREFIX		SYMBOL
pico	$= 10^{-12}$	p
nano	$= 10^{-9}$	n
micro	$= 10^{-6}$	μ
milli	$= 10^{-3}$	m
kilo	$= 10^{3}$	k
mega	$= 10^{6}$	M
giga	$= 10^{9}$	G
tera	$= 10^{12}$	T

Symbols for Physical Quantities

PHYSICAL QUANTITY	DEFINITION	SYMBOL
space and time:		
length		l
breadth		b
height		h
radius		r
diameter		d
diameter of molecules		σ
path, length of arc		s
plane angle		α, φ
solid angle		ω
area		A, S
volume		V, v
wave length		λ
wave number	$1/\lambda$	σ
circular number	$2\pi/\lambda$	k
time		t
period		T
frequency	$1/T$	ν, f
angular frequency	$2\pi\nu$	ω
velocity	$\mathrm{d}s/\mathrm{d}t$	v
angular velocity	$d\varphi/\mathrm{d}t$	ω
acceleration	$\mathrm{d}v/\mathrm{d}t$	a
acceleration of gravity		g
mass:		
mass		m
density	m/V	ρ
moment of inertia		J, I
concentration		c, C
mol fraction		x, X
atomic weight		A
molecular weight		M
Avogadro's number		N
atomic number		Z
diffusion coefficient		D
force, energy:		
force		F
weight		G (W)
force moment		M
pressure		p
traction		σ
shear stress		τ
modulus of elasticity	$\sigma \,.\, l/\Delta l$	E
shear modulus	$\tau/\tan\gamma$	G
compression modulus	$p \,.\, V/\Delta V$	K
viscosity		η
kinematic viscosity	η/ρ	ν
friction coefficient		f
Planck's constant		h
energy		U, E
work		W, A
power		P
efficiency		η
heat:		
quantity of heat		Q
temperature		t, θ
absolute temperature		T, Θ
entropy		S
internal energy		U
free energy (Helmholtz)	$U - TS$	F
enthalpy, heatfunction	$U + pV$	H
free enthalpy (Gibbs)	$H - TS$	G
work		W, A
mech. equiv. of heat		J
linear expn. coefft.		α
cubic expn. coefft.		γ
thermal conductivity		λ
specific heat		c_p c_v
molar heat		C_p C_v
ratio of specific heats		$\varkappa$, γ
heat of vaporization		r, l
Joule-Thomson coeff.		μ
gas constant	Nk	R
Boltzmann const.		k
light:		
quantity of light		Q
flux of light		Φ
intensity of light source	$\mathrm{d}\Phi/\mathrm{d}\omega$	I
illumination	$\mathrm{d}\Phi/\mathrm{d}S$	E
luminance	$\mathrm{d}I/\mathrm{d}S \cos\theta$	L, B
luminous radiance	$\mathrm{d}\Phi/\mathrm{d}S$	R
absorption factor	$\alpha + \rho + \tau = 1$	α
reflection factor	$\Phi_{\mathrm{refl.}}/\Phi_0$	ρ
transmission factor	$\Phi_{\mathrm{tr.}}/\Phi_0$	τ
absorption coefficient		a
reflection coefficient		r
extinction coefficient		$\varkappa$
refractive index	$n = c/c_n$	n
velocity of light (vac.)		c
electricity, magnetism:		
quantity of electricity		Q
charge density		ρ
surface density		σ
electric current		i, I
electric density		J
electric potential		V
electric field		E
electric displacement		D
capacity		C
permittivity	D/E	ε
dielectric polarization		P
magnetic field		H
magnetic induction		B
permeability	B/H	μ
magnetic polarization		M
susceptibility	M/H	$\varkappa$
resistance		R
resistivity		ρ
conductivity	$1/\rho$	γ, σ
self inductance		L
mutual inductance		M, L_{12}
reactance	$\omega L - 1/\omega C$	X
impedance	$\sqrt{(R^2 + X^2)}$	Z
admittance	$1/Z$	Y
phase number		m
loss angle		δ
number of turns		N
power factor		$\cos\varphi$
power		P
Poynting vector		S

Note: No symbol for electromotive force is recommended.

Trends in Coal Research

J. A. DULHUNTY

THE nature and objects of coal research overseas, and of present and possible research in Australia, cover a wide range which may conveniently be divided into at least four phases:

1. *Basic Fundamental Research*, to produce new knowledge about the chemical and physical nature of coal itself, the manner of its formation and the fundamental differences between types. Research of this kind is limited because the industrialists who sponsor research cannot appreciate immediate value from results.
2. *Fundamental Applied Research*, concerning the principles which underlie the behaviour of coal in utilization and in industrial processes. This research is planned to meet urgent requirements of industrial problems, where modern development has almost exhausted the reserves of fundamental data.
3. *Technological Applied Research*, concerning problems of industrial development and application of fundamental results—to promote economical production and utilization of coal and to extend its uses. Selection of problems in any country depends upon the resources and development of that country. Very extensive facilities are being made available in some countries.
4. *Engineering Development*, being research upon equipment for production, handling and processing of coal, rather than research upon coal itself.

Overseas Production of Liquid Fuel from Coal. It is generally recognized that world resources of petroleum are failing, in so far that old oil fields are being exhausted more rapidly than new fields are being discovered and developed. Thus it appears probable that present shortages of petroleum are likely to become permanent, that world production of oil may never increase materially above present figures and that it may possibly commence to fall off in the near future. Demands for petroleum products continue to increase so rapidly that a serious shortage of petroleum was felt in the United States during the winter of 1947-48, although oil production had been at "record" level.

Much attention is therefore being paid to the production of liquid fuel from coal. In America, coal is regarded as the nation's future internal resource of liquid fuel and enormous funds are being made available for development of hydrogenation and Fischer Tropsch projects. The United States Bureau of Mines is undertaking technological applied research and engineering development on a huge scale at Pittsburgh, and private enterprise, including some of the largest oil companies, is spending vast sums on engineering development connected with improved and modified Fischer Tropsch synthesis. Very little fundamental research in this connexion is being undertaken in America, the applied work being based largely on fundamental research carried out over many years in Germany and England.

In England, a limited amount of fundamental research is being continued on production of liquid fuel, but practically no attempt is being made to establish or develop industrial plants. The attitude appears to be that processes are available if and when required and that in the meantime large-scale research on engineering development may well be left to American enthusiasm and capital. The possibility of producing liquid fuel from coal by means other than hydrogenation and Fischer Tropsch processes is receiving much attention by fundamental research workers in Britain, but not in America.

Coal-Fired Gas Turbines. An important development in coal utilization, receiving attention in both Britain and America, is the use of pulverized coal as fuel for gas turbines. The more fundamental aspects of the problem are being undertaken in England, while in the United States there seems to be a tendency to push practical application ahead of fundamental work. It is believed that the use of pulverized coal in gas turbines may increase the overall energy efficiency of railway locomotives from the present figures of 7% to 10% for steam-powered locomotives to perhaps 20% for gas turbine electric locomotives. Gas turbines fired with pulverized coal are also contemplated for marine engines in large ships now burning fuel oil. Development of the coal-fired gas turbine is receiving much impetus from the threat of petroleum shortages.

Coal as a Raw Material in the Chemical Industry. In the past coal has provided raw materials for the chemical industries solely in the form of by-products from carbonization. Chemical industries, including plastics, synthetic fibres, and structural materials, have progressed so rapidly in recent years that the demand for coal by-products is commencing to exceed the supply normally provided by the gas and coke makers. Chemical industry would benefit enormously if the whole of the coal substance could be made available as a raw material instead of the relatively small portion represented by the by-products of thermal decomposition. It is anticipated that fundamental research on the use of coal as a solid raw material for chemical industries may lead to most important and far-reaching progress. Promising results are coming forward and such research is considered to be of great importance. The problems are of a basic fundamental nature, involving the chemical and physical nature of the coal substance, its metamorphic evolution during coalification, and the principles underlying the mechanism of thermal decomposition, solvent extraction and interaction with chemicals.

Basic Fundamental Research Overseas. Research in coal physics is establishing new knowledge about the nature of coal substance and its metamorphic evolution. Results have provided information regarding the aggregational state of coal between microscopical and molecular levels, establishing coal as a highly polymerized substance in the form of an isogel with definite micellar structure. Some indication has been obtained of molecular structures and packing within the micelles, and the study of coals varying widely in rank has given a reasonably clear picture of the evolution of the micellar structure during coalification.

Very little recent progress has been made on the chemical structure of the so-called "coal molecule", although some interesting results have been obtained by mild oxidation, partial hydrogenation and solvent extraction of specific petrological constituents in coals of various rank and type. Progress in coal physics, however, has opened up a new field of attack for the chemist, and it is probable that the application of advanced techniques in physical and organic chemistry may provide important results in the near future.

Research in coal petrology is serving an important purpose in drawing the attention of physicists and chemists to the fact that coal is essentially a heterogeneous material consisting of specific petrological constituents, each of which must be considered independently in chemical and physical research. Results of petrological work are commencing to find useful application in technological applied research on coal cleaning, hydrogenation, coking, and production of raw materials for the chemical industry by means other than thermal decomposition.

Palaeobotanical research on the morphology, classification and distribution of micro-flora in coal is assuming considerable importance in the use of microspores for correlation of coal measures and coal seams and for estimation of reserves. British workers recently decided to abandon the type-numbering system previously employed for classification and spore counts and to adopt the American and European practice of using binomial nomenclature in terms of the international rules of biological terminology. Active research on spore morphology, and close co-operation between workers in different countries, is now in progress with the object of providing the necessary background for more advantageous use of micro-flora in coal-survey work.

Liquid Fuel Production Research for Australia. In the absence of internal petroleum resources, Australia must rely on supplies from overseas or else produce liquid fuel from coal. Technological applied research on hydrogenation and Fischer Tropsch synthesis is so far advanced in America and is being carried out on such a large scale, that enormous research undertakings would be required in Australia before any worthwhile contribution could be made to practical problems of production. The necessary outlay and facilities for such research would appear to be out of all proportion to the industrial and financial position. On the other hand, fundamental research on liquid fuel production from Australian coals, on an advanced basis and of high standard, could be undertaken with moderate outlay and facilities. Results equal to those obtained in other countries could be expected. Furthermore, it may be considered very desirable for Australia to have research personnel experienced and interested in liquid fuel production, as such production may become necessary in the future.

It is possible that Australia's best policy would be:

(i) to undertake fundamental research on production of liquid fuel from local coals;

(ii) to leave applied research, in the form of engineering development, to those countries already appropriating vast financial and industrial resources for such work;

(iii) if, and when, industrial production becomes necessary in Australia, to install the most highly developed plants at that stage—our research personnel then being in possession of fundamental knowledge about processes and the behaviour of Australian coals in relation to production of liquid fuel.

Research on Availability of Australian Coals for Industry. Coal varying in nature and properties occurs at widely separated places within the Commonwealth, and industrialization in different areas is limited largely by the availability of suitable coal resources. For the purpose of facilitating industrial development and using all potential coal resources (brown coals, sub-bituminous coals and bituminous coals) it would appear very important to extend research on the preparation of coals normally unsuitable for standard industrial use, and on the adaptation of equipment to the use of such coals. Work of this kind calls for investigations in all four sections of coal research—basic fundamental research on the nature and occurrence of coals of different rank and type; fundamental applied research on their behaviour and processing; technological applied research on industrial application of coal, with preparation and development of suitable processes to use the coals; and engineering development on design and adaptation of coal burning and coal-processing equipment. A valuable purpose would be served by a policy of encouraging work in each section by provision of research facilities and of maintaining close liaison between each section of research, then co-ordinating results with the ultimate object of making available to industry all possible resources of coal within the Commonwealth.

Fundamental Applied Research for Australia. In addition to an exhaustive chemical

and physical survey of Australian coals, which is of prime importance, it is considered that fundamental applied research could be directed towards:

(i) The utilization of coal normally unsuitable for industrial use, by investigating the fundamental nature of those properties which make the coals unsuitable, and the more fundamental aspects of processes for making them available.

(ii) The processing of Australian coals to provide raw materials for the establishment of those chemical industries undergoing rapid development in other countries—particular attention being paid to oxidation of coal in production of mixed organic acids; to chemical attack on coal substance by solvent extraction and chemical interaction; and to production of moulded structural materials.

(iii) Solution of specific fundamental problems arising from time to time in connexion with production and utilization of Australian coals.

(iv) The routine use of micro-flora in coal survey work on correlation of seams and determination of reserves.

Basic Fundamental Research for Australia. Research of this nature is as urgently needed in Australia as in any other country possessing coal resources. As the object of the work is to produce new fundamental knowledge about coal by truly basic research in different branches of science, it is inevitable that its planning must depend very largely on particular interests and abilities of research personnel available and on opportunities for investigation offered by special features of nature and occurrence of coal in the country in which it is to be undertaken.

With regard to the latter, the occurrence in Australia—in very varied mode—of a particularly wide range in rank, from immature brown coal to high-rank bituminous coal with all intermediate stages represented, presents opportunities in a wide field for work on the chemical and physical nature of all ranks and on progressive changes in relation to geological factors responsible for metamorphism. Results would be valuable for fundamental applied research on availability of different coals for industry. Furthermore, the presence of well preserved micro-flora in practically all Australian coals presents unique opportunities, surpassing those in any other country, for research on floral assemblages and evolutionary trends in coal forming plant debris from Permian to Tertiary in age, and on relation to coal-measure stratigraphy. Such work would provide the necessary background for correlation of seams and determination of coal resources in Australia, as well as making an important contribution to micropalaeontological knowledge in general.

The Organization of Research in Britain

The Medical Research Council of Great Britain*

THE Medical Research Council are the expert body appointed by the Government of the United Kingdom to administer the funds provided annually by Parliament for the promotion of scientific research in medicine.

The Council were originally established in 1913, as the Medical Research Committee, and in 1920 they received their present title and constitution; at the same time they became subject to the formal direction of the specially appointed Committee of Privy Council for Medical Research. The members of this Committee are the Lord President of the Council as chairman, the Minister of Health as vice-chairman, and the Ministers in charge of the other principal departments concerned with questions of public health at home or in the Crown Colonies.

Research Programme

The programme supported by the Medical Research Council is not concerned exclusively with studying the nature and causes of disease, and with devising improved methods for its prevention, diagnosis and treatment; it deals also with the fundamental sciences of medicine, such as physiology, biochemistry, biophysics and genetics; with the maintenance of human well-being, mental as well as physical; and with physiological and psychological reactions of the normal human being to his work and environment. It may deal, indeed, with almost any question involving the human factor.

Advisory Committees

The Council consist of twelve members—three lay and nine scientific—with a secretary and other administrative officers. From 1934 till September 1949 the Secretary of the Council was Sir Edward Mellanby, whose own researches on rickets and other diseases are well known. He has now been succeeded by H. P. Himsworth, formerly Professor of Medicine at University College Hospital, London. The members of the Council are appointed by the Committee of Privy Council, the scientific members after consultation with the President of the Royal Society and with the Medical Research Council themselves. They retire in rotation at regular intervals, and the aim is always to ensure that the Council comprise a body of distinguished experts with first-hand experience of research.

To advise them in the promotion of research in special branches of medical science, the Council have the help of about fifty expert committees. These may deal with subjects of

* Contributed by Martin Ware, M.R.C.P., through the United Kingdom Information Office.

lasting interest, such as chemotherapy, vitamins, the problems of the deaf; or with more temporary questions, such as the clinical trial of a promising new drug. A committee of special interest is the Colonial Medical Research Committee, appointed jointly by the Council and Colonial Office, to direct work on tropical diseases and on nutritional and other questions affecting the health of colonial peoples. In planning research on problems of industrial well-being and efficiency the Council have the assistance of the Industrial Health Research Board, which has the status of one of their committees.

It will be realized that the Medical Research Council enjoy a high degree of autonomy, being responsible only to their directing committee of Ministers and to Parliament for the proper expenditure of their grant-in-aid. This relative independence of the Council illustrates an important principle—long accepted in Britain—that the detailed allocation of money for scientific research is best entrusted to an expert body of scientists, with only a modicum of lay help.

The Council naturally work in close association with the administrative Government departments on matters of common interest. Indeed, they are required to advise these departments on health problems within their sphere and to undertake such new researches as may be necessary for this purpose.

Research Establishments

The Council's central research laboratories comprise the National Institute for Medical Research in London, whose Director is Sir Charles Harington. The research programme here is very wide, falling under the general headings of physiology, pathology, biochemistry, pharmacology and chemotherapy, endocrinology, and physics in relation to medicine. Diseases recently under intensive study have been influenza, the common cold, malaria and (during the war) the typhus fevers. A special responsibility of the Institute is to maintain standard preparations for the biological assay of certain drugs, hormones, vitamins, and antitoxins. This is done in many instances on behalf of World Health Organization. Another institute wholly maintained by the Council for laboratory research is the Dunn Nutritional Laboratory at Cambridge.

Obviously, in any organized programme of medical research, prominence must be given to the study of clinical problems of disease and injury as seen in patients. To this end, the Council have for long maintained, wholly or in part, special departments for clinical research in medicine at two London teaching hospitals, and at a hospital for nervous diseases. More recently, they have set up a number of further research establishments in London which include centres for the study of ear diseases and eye diseases, for research on the radiotherapy of cancer, and for the study of industrial illnesses and toxicology. Units for research in human nutrition and in dental disease have also been established in London. Research on industrial injuries and skin diseases is carried out in a unit at Birmingham; in South Wales, occupational lung disease in the coal miners is being studied. At Cambridge, the Council have established an applied psychology research unit and a department of experimental medicine. Other research units of the Council in London and elsewhere in Britain are concerned with chemotherapy, the vitamins, endocrinology, microbiology and cell metabolism; with blood-grouping and the therapeutic use of blood derivatives; with electromedical and biophysical problems; and with industrial physiology, occupational psychiatry and social medicine. The list is by no means complete, but it will serve to indicate the varied scope of the Council's research activities. At the present time the Council support about 40 such research units.

Grants for Research

At the National Institute for Medical Research, and at their other research establishments, the Council employ a whole-time scientific staff, including many medical men and women. While the greater part of the funds at their disposal is thus devoted to the support of work within their immediate control, an important fraction is expended annually in the form of temporary grants made in aid of approved researches by independent investigators at universities, hospitals and other institutions throughout Britain and on occasion overseas.

In addition to their primary function of supporting medical research, the Council during the war period undertook various executive functions on behalf of the Ministry of Health, such as the establishment of blood transfusion depots, and of an Emergency Public Health Laboratory Service to augment the existing public health services in combating epidemics of infectious disease. The success of the latter arrangement was such that the Service (now known as the Public Health Laboratory Service) is being continued in peace-time, to carry out nation-wide research on problems of public health and epidemiology.

The Australian National Committees

AUSTRALIAN membership of the various International Scientific Unions is effected through the Australian National Research Council (This JOURNAL, *10*, 127, 1948). The following procedure in this connexion was adopted by the Executive Committee of the A.N.R.C. on 9 April 1948 and approved by the general meeting held in Hobart on 11 January 1949.

When Australia joins an International Scientific Union, an appropriate National Committee

in that branch of science is to be appointed by A.N.R.C. Members of the National Committee shall be appointed and hold office for two years, but are eligible for re-appointment. The National Committee is to serve as the Australian Committee of the particular International Scientific Union, and is intended to promote and co-ordinate in Australia the study of the particular branch of science, more especially in relation to its international requirements.

The National Committee may communicate on scientific and general matters direct with the International Scientific Union and its constituent Associations or Commissions; but all questions involving policy are to be referred by the National Committee to the Executive Committee of A.N.R.C., with a recommendation. Questionnaires for scientific reports received by A.N.R.C. from an International Scientific Union or any of its Associations or Commissions will be passed to the Secretary of the National Committee for reply direct. The Secretaries of National Committees should appreciate the advantage of keeping A.N.R.C. in touch with their activities by such simple means as forwarding carbon copies of certain of their correspondence to A.N.R.C. for information only.

When arrangements are being made for the holding of meetings of the International Scientific Union or its constituent Associations or Commissions, the A.N.R.C. on the recommendation of its appropriate National Committee will appoint the requisite number of delegates and will advise the Secretary of the Union.

Each International Scientific Union has a number of constituent Associations or Commissions. These constituent bodies each deal with some particular section of the science covered by the Union. A National Committee may appoint sub-committees to deal in Australia with the subject matter of each of the constituent bodies. Care should, however, be taken by the National Committee to preserve in Australia the same structure as the International Scientific Union. For example, the International Union of Geodesy and Geophysics has a constituent association entitled the International Association of Hydrology, the scientific work of which is divided among a number of Commissions formed within the Association; one of these is the Commission of Potamology: if it were found necessary by the National Committee on Geodesy and Geophysics to have a separate group actively engaged on potamology, it should be set up as a working group of a sub-committee of Hydrology.

Advice of the formation of a sub-committee or working group of a sub-committee, together with a list of its personnel, is to be given to A.N.R.C. by the Secretary of the National Committee immediately after its formation. The tenure of office of these sub-committees and working groups will be the same as that of the National Committee, and members are eligible for re-appointment.

A report is to be submitted by the National Committee to the Executive Committee of A.N.R.C. at least four weeks before the date of each general meeting of A.N.R.C.

Australia has now arranged to adhere to seven of the International Unions, and corresponding National Committees have been appointed, as follows.

National Committee of Astronomy

R. v. d. R. Woolley (chairman), Sir Kerr Grant, A. R. Hogg, D. J. K. O'Connell, H. S. Spigl, H. W. Wood. Secretary: Dr. A. R. Hogg, Commonwealth Observatory, Mt. Stromlo, A.C.T.

National Committee of Chemistry

R. S. Andrews, N. S. Bayliss, E. J. Hartung, T. Iredale, T. G. H. Jones, E. C. Kurth, R. J. W. Le Fevre, G. Leeper, A. K. Macbeth, V. M. Trikojus, I. W. Wark, and the President of the Royal Australian Chemical Institute (*ex officio*). Secretary: Dr. I. W. Wark, Chief of Division, Division of Industrial Chemistry, Commonwealth Scientific and Industrial Research Organization, Box 4331, Melbourne.

National Committee of Biological Sciences

J. G. Wood (Botany), H. N. Barber (Experimental Cytology), P. D. F. Murray (Embryology), A. J. Nicholson (Entomology), W. L. Waterhouse (Genetics), F. M. Burnet (Microbiology), O. W. Tiegs (Zoology). Secretary: Professor O. W. Tiegs, Department of Zoology, University of Melbourne, Carlton, N.3, Victoria.

National Committee of Crystallography

J. Bannon, W. Boas, W. H. Bryan, R. I. Garrod, A. Mathieson, D. P. Mellor, G. D. Osborne, R. T. Prider, A. L. G. Rees, (Mrs.) C. Rogers, J. Shearer, C. N. Tattam, W. A. Wood. Secretary: Dr. R. I. Garrod, Defence Research Laboratories, Maribyrnong, Victoria.

National Committee of Geodesy and Geophysics

R. L. Aston, W. H. Bryan, K. E. Bullen, L. A. Cotton, F. M. Johnston, E. Kraus, F. Loewe, D. F. Martyn, D. J. K. O'Connell, H. G. Raggatt, J. M. Rayner, C. M. Tattam, F. W. G. White, F. M. Wood, R. v. d. R. Woolley. Secretary: J. M. Rayner, Chief Geophysicist, Commonwealth Bureau of Mines and Mineral Resources, Collins Street, Melbourne, C. 1, Victoria.

National Committee of Pure and Applied Physics

R. C. L. Bosworth, G. H. Briggs, C. E. Eddy, N. A. Esserman, Sir Kerr Grant, A. F. A. Harper, A. R. Hogg, Sir John Madsen, L. H. Martin, A. D. Ross, E. L. Sayce, H. C. Webster, F. W. G. White. Secretary: N. A. Esserman, Chief of Division, Division of Metrology, Commonwealth Scientific and Industrial Research Organization, National Standards Laboratory, University Grounds, Chippendale, N.S.W.

National Committee of Radio Science

R. E. Aitcheson, C. W. Allen, V. A. Bailey, E. G. Bowen, W. S. Butement, A. L. Green, L. G. H. Huxley, J. C. Jaeger, F. J. Lehany,

Sir John Madsen, D. F. Martyn, G. H. Munro, J. L. Pawsey, J. M. Rayner, H. C. Webster, F. W. G. White, R. v. d. R. Woolley, F. W. Wood, E. P. Wright. Secretary: Dr. D. F. Martyn, Commonwealth Observatory, Mt. Stromlo, A.C.T.

At a meeting of the National Committee of Geodesy and Geophysics which was held in Melbourne on 2 December 1949 it was decided to appoint sub-committees as follows:

Geodesy: J. M. Rayner, R. L. Aston, B. P. Lambert (Secretary).

Seismology: K. E. Bullen, O. A. Jones, D. J. K. O'Connell (Secretary).

Meteorology: J. C. Foley, F. Loewe, C. H. B. Priestley (Secretary).

Terrestrial Magnetism and Atmospheric Electricity: J. M. Rayner, L. S. Prior, D. F. Martyn (Secretary).

Vulcanology: W. H. Bryan, N. H. Fisher (Secretary), and one other to be appointed (from Victoria).

Physical Oceanography: G. D. Osborne (Secretary), to nominate two other members.

Hydrology: C. Mulholland, R. L. Aston, N. H. Fisher, E. S. Hills (Secretary), with power to co-opt.

News

Pollock Memorial Lecture

The Pollock Memorial Lectureship was founded in 1923 as the result of an appeal by the University of Sydney and the Royal Society of New South Wales to establish a memorial to Professor J. A. Pollock, who had occupied the Chair of Physics in the University from 1899 to 1922. The Lecture is to be delivered in general at intervals of three years. It is to be open to the public, but is to be of a nature such as to encourage research and to stimulate the lecturer and the public to acquire new knowledge.

The first Lecture was delivered by Professor T. M. Cherry, of the University of Melbourne, on 28 October 1949, upon the subject 'The Flow of Gases'. Professor O. U. Vonwiller gave a short talk upon the life and work of Professor Pollock.

Edgeworth David Medal

The Edgeworth David Medal of the Royal Society of New South Wales is awarded annually for research published by a scientist under the age of thirty-five years. It is granted for a distinguished contribution of work done mainly in Australia or its Territories or adjacent Seas, or contributing to the advancement of Australian science. The fields of award are changed in annual rotation, according to the following Groups:

A. Mathematics, Physics, Chemistry, Biochemistry, Astronomy, Meteorology, Engineering, and related Sciences.

B. Geology, Botany, Zoology, Physiology, and related Sciences.

C. Psychology, Anthropology, Sociology, Economics, Geography and related Sciences.

The first award was for the year 1948.* The award for 1949 will be made for work in the subjects of Group B published before 1 January 1950. The recipient must not have reached the age of thirty-five years before 1 January 1950. Nominations are invited from scientific bodies in Australia. They should submit details of the nominee's work and should reach the Royal Society of New South Wales not later than 28 February 1950.

Imperial Chemical Industries Fellowships

Applications are invited for I.C.I. Research Fellowships in Biochemistry, Chemistry, Engineering, Pharmacology, Physics, or allied subjects. These will normally be tenable from 1 October 1950, for three years in the first instance. The salary will depend on qualifications and experience, but will be within the range of £500 to £850 (sterling) a year.

Detailed regulations and application forms can be obtained from the Academic Registrar, University of London, Senate House, W.C.1. Applications must be received at that address not later than 30 April 1950.

Turner and Newall Research Fellowships

Applications are invited for a Turner and Newall Fellowship in Engineering, Inorganic Chemistry, Physics, or allied subject, tenable from 1 October 1950, normally for three years in the first instance. The salary will depend upon qualifications and experience, but will be within the range of £500 to £850 a year, sterling.

Detailed regulations and application forms can be obtained from the Academic Registrar, University of London, Senate House, W.C.1. Applications must be received at that address not later than 30 April 1950.

C.S.I.R.O. Publications

The Commonwealth Scientific and Industrial Research Organization is to publish two new journals—*The Australian Journal of Agricultural Research* and *The Australian Journal of Applied Science*. These will appear quarterly and it is expected that four issues of each will appear in 1950. The subscription to each journal will be £1 10*s*. a year or 7*s*. 6*d*. a copy.

The *Journal* of the former Council for Scientific and Industrial Research ceased publication with Volume 21, No. 4 (1948).

The Royal Society

At the 287th Anniversary Meeting of the Royal Society the following were elected as officers and council for the ensuing year. President, Sir Robert Robinson, O.M.; Treasurer, Sir Thomas Merton; Secretaries, Sir Edward Salisbury, Sir David Brunt; Foreign

* This JOURNAL, *11*, 161.

Secretary, Professor E. D. Adrian, O.M. Councillors: R. A. Bagnold, G. L. Brown, H. Davenport, F. G. Gregory, Sir Cyril Hinshelwood, R. P. Linstead, G. F. Marrian, H. S. W. Massey, F. E. Simon, Sir William Stanier, Sir George Thomson, H. G. Thornton, C. E. Tilley, F. M. R. Walshe, V. B. Wigglesworth, S. Zuckerman.

Vice-Presidents: Sir Thomas Merton (Treasurer); Sir Edward Salisbury (Biological Secretary; Director of the Royal Botanic Gardens, Kew); Sir David Brunt (Physical Secretary; Professor of Meteorology, Imperial College of Science and Technology); C. E. Tilley (Professor of Mineralogy and Petrology, Cambridge).

In his presidential address Sir Robert Robinson reviewed the important advances in sterinoid chemistry, referring to the contribution of the organic chemist in the elucidation of the structure of certain vitamins and hormones. He made particular reference to the chemistry of cortisone (i.e., compound E, with which certain beneficial effects have been obtained in the treatment of rheumatoid arthritis) and called for new ideas and methods in the search for the synthesis of cortisone or similar substances. He said that there is a great field for investigation and he urged the international organization of a supreme effort similar to that made in the penicillin field during the war. The successful outcome of such an effort would be of profound significance for the progress of biological science and for the greater health and happiness of mankind.

Royal Society Medals

His Majesty the King has been graciously pleased to approve recommendations made by the Council of the Royal Society for the award of the two Royal Medals for the current year as follows:

To Sir George Thomson, F.R.S., for his distinguished contributions to many branches of atomic physics, and especially for his work in establishing the wave properties of the electron.

To Professor R. A. Peters, M.C., F.R.S., for his distinguished biochemical researches, in particular his investigations of (i) the biochemical role of vitamin B_1 in tissue metabolism; and (ii) the mechanism of the toxic action of lewisite and other arsenical compounds.

The following awards of medals have been made by the President and Council of the Royal Society:

The Copley Medal to Professor G. C. de Hevesy, For.Mem.R.S., for his distinguished work on the chemistry of radioactive elements and especially for his development of the radioactive tracer technique in the investigation of biological processes.

The Davy Medal to Professor A. R. Todd, F.R.S., for his structural and synthetic studies and achievements in organic and biochemistry, with special reference to vitamins B_1 and E and the naturally occurring nucleosides.

The Sylvester Medal to Professor L. J. Mordell, F.R.S., for his distinguished researches in pure mathematics, especially for discoveries in the theory of numbers.

The Hughes Medal to Professor C. F. Powell, F.R.S., for his distinguished work on the photography of particle tracks and in connexion with the discovery of mesons and their transformation.

D.S.I.R. Information

The U.K. Department of Scientific and Industrial Research has recently issued brief public reports of research information on the following subjects.*

New Design Methods for Welded Steel Structures, as a result of research by the British Welding Research Association in the University of Cambridge, which has produced a theory taking into account both the elastic and plastic properties of steel.

Filling and Sealing Materials for Joints in Concrete Roads, published as Road Note No. 7, price 4*d*. Fillers must stretch without cracking and without separating from the joint sides; must stand hard wear and must not liquefy in hot weather but must be easily liquefied for pouring.

Damage to Roads Caused by the Drought of 1947, published as Road Note No. 6, price 9*d*. Reference is made to the effect of fast-growing vegetation close to the road.

The Swelling of Wood under Stress, published as a book, price 6*s*. A critical approach is made to the study of the behaviour of any natural material which is not homogeneous and is sensitive to past treatment. The book deals with the structure of wood, types of sorption of water, effects of restraints; anisoptopic elasticity; generalization of osmotic pressure theory; plasticity of gels and hysteresis, and the application of thermodynamic method to empirical data.

Errors in Direction Finding, caused by tilts in the ionosphere, published as Radio Research Special Report No. 19, price 9*d*. Some of the tilts are systematic and occur at particular times such as sunrise. They may amount to one or two degrees and may extend some tens of kilometres.

The Storage of Apples, Interim Report on Skin Coatings, published as Food Investigation Technical Paper No. 1, price 9*d*. The paper deals particularly with internal alcoholic disorders resulting from skin coatings.

Visiting Scientists

The United Kingdom delegation to the Commonwealth Specialist Conference in Agri-

* See also, in this issue, Book Notices, page 119

culture, held in August, was led by Sir Edward Salisbury, F.R.S., Director of the Royal Botanic Gardens, Kew. Other members included Professor F. G. Gregory, of the Imperial College of Science and Technology; Professor T. Wallace, Director of the Long Ashton Agricultural and Horticultural Research Station; P. J. G. Mann, of Rothamsted; P. S. Nutman, of Rothamsted; James Stewart, of the Moredun Research Institute; J. W. Howie, of the Rowett Research Institute, Bucksburn; J. B. E. Patterson, of the National Advisory Agricultural Service, Bracken Hill; and H. H. Green, of the Veterinary Laboratory, Weybridge.

The Canadian delegation included Professor E. W. Crampton of McGill, and J. C. Woodward of the Department of Agriculture; the Indian delegation, T. J. Mirchandani, P. U. Dabadghas and R. V. Tamhame, all of the Indian Agricultural Research Institute; the South African delegation, J. C. Bonsma of the Department of Agriculture, and I. S. Perold of the Stellenbosch-Elsenburg College. Representing the Colonies was B. A. Keen of the East African Agriculture and Forestry Research Organization.

The New Zealand delegation included F. J. Filmer and R. E. R. Grimmett of the Department of Agriculture, Professor I. E. Coop of Canterbury Agricultural College, C. P. McMeekan of the Ruakura Animal Research Station, and J. Melville, P. D. Sears and A. C. S. Wright, all of the D.S.I.R. In addition, M. A. Black of the D.S.I.R., E. A. Clarke of Massey Agricultural College, and N. Robertson of the Air Department attended as observers.

Observers attending from the United States of America included Professor W. Albrecht of the University of Missouri, Professor J. Bonner of the California Institute of Technology, and K. Hammer and Professor P. R. Stout of the University of California.

Professor Sydney Chapman of the University of Oxford, has been in Australia at the invitation of the Commonwealth Government, upon the recommendation of Dr. R. v. d. R. Woolley. He has visited the Commonwealth Observatory, the Bureau of Mineral Resources and other organizations, and has met the National Committees in Geodesy and Geophysics and in Scientific Radio. Opportunity was taken to arrange lectures by Professor Chapman on subjects such as 'Atmospheric Tides', 'Magnetic Storms', and 'Aurorae'.

Dr. G. M. Lees, of the Anglo-Iranian Oil Co. Ltd., lectured in Sydney in December, under the auspices of the University of Sydney and the Royal Society of New South Wales, upon the subject, 'Geology of the Oilfields in the Middle East'.

Discovery of Antrycide

THE establishment of a cattle industry in four-and-a-half million square miles of Africa has hitherto been prevented by the disease of trypanosomiasis in cattle, which is known as 'sleeping sickness' in human beings. It was estimated that half a million African natives died from this disease between 1896 and 1906. As a result of a commission of investigation sent to Africa by the Royal Society in 1902, Bruce discovered the life-history of the trypanosome parasites—that they are conveyed by the tsetse fly (*Glossina*) and have their natural host in the big game of the fly belt. In connexion with the post-war development and re-adjustment of the British Commonwealth, a team of chemists and biologists from Imperial Chemical Industries commenced a new attack on the problem of trypanosomiasis in 1944. The team was headed by the late Dr. F. H. S. Curd[a] and Dr. D. G. Davey,[b] who had been joint discoverers of *paludrine*, the antimalarial drug which was announced in 1945. It also included Dr. C. M. Scott[c] and Dr. W. A. Sexton.[d]

Research began with the development of a new field of synthetic heterocyclic compounds (i.e. substances in which the organic carbon ring contains other atoms such as nitrogen, oxygen or sulphur), which were of a type likely to be effective against trypanosomes. These were tested in the Manchester laboratories, upon mice which had been given trypanosome infections. Eventually a compound was found which had a slight effect upon the disease, and from this start more potent compounds were developed, of which the most effective was given the serial number 'M.7555'. The British Government was unwilling to allow cattle to be infected with the disease for experiment within Britain; so the laboratory and personnel had to be transported to the endemic belt in Africa for the next stage of investigation. This was done with the collaboration of the Tsetse Fly and Trypanosomiasis Committee of the Colonial Office.

Field experiments were based upon laboratories established at Khartoum, Nairobi and Entebbe. The incidental problems involved were unusual in chemotherapy research: the subject animals to be collected and handled were wild cattle; they were eaten by lions during the course of experiments; observations

[a] Francis Henry Swindon Curd, born 1909, did research at the London School of Hygiene and Tropical Medicine before joining I.C.I. in 1933. After a short period on dyestuffs, he took up work on trypanocidal compounds. He continued to work on the chemotherapy of tropical diseases and was, with D. G. Davey, awarded the gold medal of the Society of Apothecaries for the discovery of paludrine. He was one of five killed in the Stockport railway disaster, 30 November 1948.

[b] D. Garnet Davey, born 1912, proceeded from Cambridge to Harvard on a scholarship. After terms as lecturer in zoology and parasitologist at Cambridge and Cardiff, he joined the I.C.I. in 1941 and organized the Tropical Disease unit at Manchester.

[c] Head of the Biological Department of I.C.I from 1937; formerly lecturer in Materia Medica at Edinburgh.

[d] Associate Research Manager of the Dyestuffs Division of I.C.I.; in charge of chemical research on medicinals; one of the discoverers of the selective weedkiller, *Methoxone*.

were interrupted when a chemotherapist was chased up a tree by a rhinoceros; and the laboratory mice were devoured by ants. In addition, the test cattle succumbed to foot-and-mouth disease, rinderpest and East Coast fever. The tests began in January 1948, and it was soon decided that 'M.7555' would cure cattle suffering from all forms of trypanosomiasis encountered; that it has a prophylactic effect; and that it cures the disease in horses, camels and other animals. It has been given the name *Antrycide*.

The drug renders cattle immune from *Trypanosome congolense*, in most cases for six months; and from *T. vivax*, in most cases for four to five months. Antrycide has been tested with success against *T. brucei*, in cattle, horses and dogs; against *T. evansi*, in camels; and against *T. simiae*, in pigs. Experiments are proceeding in relation to the various forms of the disease and to determine periods of immunity. It is claimed that antrycide has no toxic effects and produces no undesirable reactions in the animal, locally or generally. It may be administered without the presence of a skilled veterinarian. Antrycide has not yet been tested against human sleeping-sickness, which has for some years been under much-improved control as regards drugs and diagnosis. Field trials are in process in both East and West Africa. It is realized that there are various factors to cause failure in large-scale application of the drug, and many veterinarians are by no means sanguine as to the actual elimination of trypanosomiasis.

University of Melbourne

Dr. C. B. O. Mohr, senior lecturer in Theoretical Physics, has been appointed to the status of Associate Professor. A former graduate of Melbourne, and 1851 Exhibition Scholar in the Cavendish Laboratory at Cambridge, Associate Professor Mohr was for ten years lecturer in the University of Cape Town and was appointed to the staff at Melbourne in 1946. One of the few theoretical physicists in Australia, he has been associated with the considerable volume of practical work in nuclear physics which is being developed in Melbourne.

Dr. E. R. Love, senior lecturer in Mathematics, has been appointed to the status of Associate Professor. A former graduate of Melbourne, and Aitcheson Travelling Scholar at Cambridge, Associate Professor Love was appointed to the staff at Melbourne in 1940. He has recently returned from Trinity College, Cambridge, after taking up a Fellowship awarded to him on leaving the College in 1939. During the war he was engaged on mathematical research with the Munitions Supply Laboratories at Maribyrnong and later with the Aeronautical Laboratory of the C.S.I.R. As a pure mathematician, his field is in the theory of functions of a real variable.

Dr. W. J. Tuckfield will continue as Acting Professor of Dental Prosthesis until the end of 1951. The following appointments have been made: G. Buchdahl, as senior lecturer in charge of the Department of General Science; E. R. Trethewie, now at the Wellcome Institute, London, as temporary lecturer in Physiology; W. D. Falk, of Oxford, as senior lecturer in Philosophy; W. E. King, as Stewart Lecturer in Pathology.

The vacancy on the University Council which was caused by the retirement of the Rt. Hon. Sir John Latham has been filled by the appointment of Dr. Lucy Bryce. It is recalled that the late Dr. Georgina Sweet was the only previous woman member of the Council. Dr. Bryce has worked in the field of bacteriology and clinical pathology, and between 1922 and 1928 was engaged in research at the Walter and Eliza Hall Institute and at the Lister Institute, London.

Associate Professor Tattam, of the Department of Geology, is to visit Nigeria from December to March. A. M. Clark, senior lecturer in Zoology, has returned from the Molteno Institute, Cambridge, where he has been working as 1851 Exhibition Scholar. N. H. Rosenthal, Director of Visual Aids, is visiting Europe. Miss R. Sugden, lecturer in Chemistry, and S. J. Lengyel, research officer in Commerce, have returned after leave of absence abroad.

The Degree of Doctor of Philosophy has been awarded to F. K. Crowley, in the School of History, and to C. J. Stratman, in the Department of Physiology. Dr. Crowley is at present at Balliol College, Oxford, and Dr. Stratman at the University of Edinburgh. Both are research scholars of the Australian National University.

The State Government has agreed to provide a further sum of £15,000, making a total grant of £55,000, for the additional storey on the Physics Building. Pending further developments, the Department of Clinical Studies is to continue until the end of 1950 at least, with Professor MacCallum as Acting Director. A Department of Psychology is to be established at the Canberra University College, with A. A. Gilchrist as temporary lecturer. Patrick Pentony, of the University of Western Australia, has been appointed senior lecturer in Psychology at the College, to commence duties in 1951.

The following benefactions have been received—£2,000 from Dunlop Rubber (Australia) Ltd. for research scholarships in Chemistry and Physics for 1948 and 1949; £233 as bequest from the late Dr. Haley; £50 from V. N. T. Karagheusian for the Marie Aghassian Fund; £10 10*s*. from J. G. Reid for the School of Education.

University of Sydney

The quinquennial election of ten Fellows to the Senate, by a poll of graduates, resulted in the election of W. A. Selle, Lieut.-Colonel Sir Charles Bickerton Blackburn, Mr. Justice E. D. Roper, Mr. W. J. V. Windeyer, Dr.

Francis Lions, Dr. J. A. Collins, Emeritus Professor F. A. Bland, Sir Henry Barraclough, Mr. H. D. Black and Dr. C. G. McDonald.

The University has instituted the position of Public Relations Officer. The officer will act as Director of the University's Centenary Celebrations, which are to be held in 1952. A public appeal for funds is to be launched at the beginning of 1950. The University came into being with the passing of the University Act in 1850; Royal Assent was given in 1851 and classes began in 1852.

University of Queensland

Professor G. Elton Mayo, who was the first lecturer in Philosophy in the University, died in Surrey at the age of sixty-eight, on 1 September. He was a graduate of the University of Adelaide and later studied medicine at Edinburgh before turning to psychology. His books include *The Human Problems of an Industrial Civilization* (1933), *The Social Problems of an Industrial Civilization* (1945), *The Political Problem of Industrial Civilization* (1947), and *Some Notes on the Psychology of Pierre Janet* (1948). He left Australia in 1923 and in 1926 was appointed Senior Professor in the newly formed Department of Industrial Research at Harvard. He retired in 1947.

Professor William Stephenson has taken up his duties as the first Professor of Zoology in the University. He is a graduate of King's College, Newcastle-on-Tyne, in both Zoology and Education. He was successively research assistant to Professor Hobson, demonstrator at King's College, assistant lecturer at Bristol, and naturalist at the Dove Marine Laboratory, Cullercoats. His field of research is marine biology and parasitology, with a bias towards experimental physiology.

Dr. Norman Henderson, who has for the past two years been engaged in research in the social psychology of education, in London and Europe, has returned to duty in the University. R. F. Langdon, who has been awarded a Nuffield Fellowship, has left for England, to work at the Cambridge School of Botany and the Commonwealth Mycological Institute, Kew. His special interests have been the diseases of pasture plants, especially the ergots of Queensland grasses.

It has been decided to establish a Department of Mining, with a full-time course in Mining Engineering, extending over four years and having the first year in common with the other Engineering courses. The position of Professor has been advertised and it is expected that the course will be in operation in 1950. The State Government has granted £2000 a year, together with a sum to cover initial expenditure on plant, and the Chamber of Mines has offered £2,000 a year for five years.

School of Applied Science in Geology

When the utilitarian demands of pioneering days subsided, geology and other sciences were left to a calmer period of more academic research. In post-war years, however, as the late Professor Hawken expressed it, 'the big bad wolf of utilitarianism has become a friendly shepherd dog who rounds up the University flock, enlivens the laggards in research, and cherishes the lambs of pure culture'.

Calls for geological help come not only from mines, but for such needs as water supplies, ceramics, soils, building materials, dam sites, railway locations, aerodromes, and general resources surveys for land utilization and regional development. To meet these demands, the University of Queensland has established a four-year course in Applied Geology within its Department of Geology and Mineralogy. For the first two years the courses, s those for the pure geologist, comprise Geology, Chemistry and Mathematics. In the third year there are lectures on mining methods, assaying and related topics. The fourth year is devoted entirely to Applied Geology, including geological surveying, geophysical prospecting, interpretation of aerial photographs, shoreline problems, mineral economics, the geology of petroleum and coal, hydrology, soils, gemstones and clays. Associate Professor F. W. Whitehouse is in immediate control of the course.

University of Western Australia

Dr. B. J. Grieve, who is in charge of the Department of Botany, has been elected a Fellow of the Linnean Society.

A four-year course in optometry is to be established. An optometrical laboratory has been opened in the Department of Physics with the aid of grants from the Commonwealth Government, the Optometrists' Registration Board, and the Australian Optical Co.

University of Adelaide

Dr. G. M. Badger, of Glasgow, has taken up his duties as senior lecturer in Chemistry.

The degree of Doctor of Philosophy has now been established. For the present it will be restricted to the Faculties of Science, Agricultural Science and Engineering.

The extensive building programme begun four years ago is still delayed by shortages of material and other restrictions. The Medical School, Geology building, and new Engineering wings are in various stages of construction.

Professor Brian Tew, of the Chair of Economics, has been appointed as Professor of Economics in the University of Nottingham.

University of New Zealand

The Chair of Mechanical Engineering at the Auckland University College has been filled by the appointment of Dr. G. C. Dalton, a former New Zealand Rhodes Scholar who has been a scientific officer at the Harwell Atomic Research Station.

University of Otago

The Chair of Philosophy has been filled by the appointment of J. A. Passmore, senior

lecturer in the University of Sydney and editor of the *Australian Journal of Philosophy.*

Personal

Dr. Walter Boas, principal research officer in the C.S.I.R.O. Division of Tribophysics, has been appointed Chief of the Division in succession to Dr. S. H. Bastow, who has been appointed to the Executive. Miss Norma McArthur, formerly statistician and Haley Research Scholar at the Walter and Eliza Hall Institute, has been appointed lecturer in Demography at University College, London. D. J. M. Bevan, of the University of Melbourne, has been awarded a junior fellowship to work under J. S. Anderson at the Atomic Research Station at Harwell. Mrs. C. F. Bartz, formerly lecturer in Economic Geography in the University of Melbourne as Patricia McBride, has graduated Doctor of Philosophy in the University of California.

The Scientific Societies

Royal Society of Tasmania

November: V. V. Hickman, The morphology and habits of spiders.

Royal Society of New South Wales

November: Exhibitions and films of scientific interest.

December: F. Chong, Involutions on a conic and orthogonal matrices.

J. A. Dulhunty, The nature and occurrence of peat at Hazelbrook, N.S.W.

F. P. Dwyer and E. C. Gyarfas, The resolution of the tris-o.phenanthroline nickel II ion.

F. P. Dwyer and H. Wooldridge, A note on the reaction between chromium II salts and o.phenanthroline.

L. M. Simmons and M. J. Canny, Determination of the boiling points of aqueous nitric acid.

A. J. Birch, Reduction by dissolving metals—VIII, Some effects of structure on the course of reductive fission.

Dorothy Carroll, R. Brewer and J. E. Harley, Pebbles from the Upper Hunter River Valley, N.S.W.

F. P. Dwyer and E. C. Gyarfas, The resolution of the tris-o.phenanthroline ferrous ion and the oxidation of the enantiomorphous forms.

P. H. Gore and G. K. Hughes, A note on some 4-methoxybenzeneazo derivatives of resorcinol.

G. K. Hughes and E. O. P. Thompson, Studies in dimethylation of thioanisole.

L. E. Lyons, Action of photochemically produced radicals on acetylene.

G. F. K. Naylor, A further contribution to the geology of the Goulburn District, N.S.W.

G. D. Osborne, The Kuttung vulcanicity of the Hunter-Karuah District, N.S.W., with special reference to the occurrence of ignimbrites.

Royal Society of Victoria

November: Dorothy Hill, Middle Devonian corals from the Buchan District, Victoria.

December: E. D. Gill, Sandringham Sands—A formational name for certain Tertiary sediments in the vicinity of Melbourne, Victoria.

J. G. Baldwin, A soil survey of the Shire of Whittlesea, Victoria.

A. J. McIntyre (lecture), Land utilization in the Shire of Whittlesea, Victoria.

Royal Society of South Australia

November: H. B. S. Womersley, The marine algae of Kangaroo Island—III, List of species, I.

E. R. Segnit, The soda-rich composite intrusive stock located in the Boolcoomatta Hills, S.A.

H. B. S. Womersley, Studies on the marine algae of Southern Australia—III, Notes on Dictyopteris Lamouroux.

D. Mawson, Elatina Glaciaton—A third Glacial Age recorded in the Adelaide System.

R. K. Johns and J. M. Kruger, Murray Bridge and Monato granites and associated rocks of the metamorphic aureole.

Royal Society of Queensland

November: C. T. White (memorial lecture), F. M. Bailey—his life and work.

October: W. H. Bryan and O. A. Jones, Contributions to the geology of Brisbane —I, Local applications of the Standard Stratigraphical Nomenclature.

I. M. Mackerras, Marine insects.

Royal Society of Western Australia

October-November: E. R. Beech (lecture), Pharmacology and nerve conduction.

C. A. Gardner (exhibit), Plants used as native remedies.

Royal Australian Chemical Institute

Council (from 21 September 194[illegible]) Gepp (President), H. E. Hill (Vice-President), G. Junck (Hon. Gen. Treas.), H. W. Strong (Hon. Gen. Sec.), J. Cuming, A. W. Peirce, H. G. Pyke, L. H. Smith, H. L. Wood.

Registrar: E. N. Dimmock, 55 Collins Place, Melbourne.

State Branches

N.S.W.: H. G. Pyke (President), M. B. Walters (Sec.), 39 Martin Place, Sydney.

Queensland: H. L. Wood (President), J. R. Hinchley (Sec.), 62 Eagle St., Brisbane.

South Australia: A. W. Peirce (President), G. B. Jones (Sec.), C. W. Bonython (Hon. Asst. Sec.), 4 Mawson St., Nailsworth, S.A.

Tasmania: H. E. Hill (President), F. H. C. Kelly (Sec.), 152 Augusta Rd., New Town, Hobart.

Victoria: L. H. Smith (President), R. C. Edquist (Sec.), 55 Collins Place, Melbourne.

Western Australia: J. Cuming (President), F. W. Steel (Sec.), J. C. Cavanagh (Hon. Asst. Sec.), 23 Barrack St., Perth.

Linnean Society of New South Wales

September: G. D. Osborne, The stratigraphy of the Lower Marine series of the Permian System in the Hunter River Valley, N.S.W.

A. R. Woodhill, A note on experimental crossing of *Aedes (Stegomyia) scutellaris scutellaris* Walker and *Aedes (Stegomyia) scutellaris katherinesis* Woodhill (Diptera, Culicidae).

October: H. F. Purchase and J. M. Vincent, A detailed study of the field distribution of strains of clover nodule bacteria.

A. Loveridge, The cotypes of *Fordonia papuensis* Macleay.

Medical Sciences Club of South Australia

November: J. Cleland, Clinical interpretation of Vitamin B excretion tests.

P. Trudinger, Amino acid economy of the bacterial cell and the mode of action of chemotherapeutic agents.

December: Discussion on medical education.

Victorian Society of Pathology and Experimental Medicine

August: F. H. Shaw and G. Bentley—The antagonism of morphine.
F. M. Burnet—Haemolysis by Newcastle disease virus.
E. S. J. King—Testicular tumours.
D. T. Oxer—Verminous aneurysm in a horse.

October: A. Ferris, Correlation of serological type with toxigenicity in strains of *C. diphtheriae*.
S. Fisher and E. V. Keogh, Lysis in the presence of complement of erythrocytes which have adsorbed as bacterial fraction and its corresponding antibody.
A. W. Turner and V. E. Hodgetts, Relationship of lactic acid to deaths in sheep after excessive consumption of wheat.
M. Kelly, The neurogenic factor in rheumatic inflammation.
K. Bowden (demonstration), The pathology of some causes of sudden deaths in infants.

December: R. Mushin, A new antigenic relationship between faecal bacilli due to a common β antigen.
T. L. Althausen (University of California), Hormonal and vitamin factors in intestinal absorption.
G. Reid, Liberation of heparin and histamine by tubocurarine.
A. V. Jackson (demonstration), Congenital abnormalities of the heart.

Society for Experimental Biology of New South Wales

November: B. W. Scott, Some practical aspects of the use of radioactive isotopes.
R. G. H. Barbour, Streptomycin-resistant staphylococcus.
P. Rountree (demonstration), the slit sampler.

British Astronomical Association, N.S.W. Branch

July: W. H Wood (presidential address), Tides.

August: W. H. Wood, The Sun.
A. V. Green, Mars and its lessons.

September: S. J. Elwin, Machine manufacture of surfaces of optical quality.

October: A. York, The size of the Universe.
J. S. Dence, The Moon and its craters.

November: T. Entwhistle, Comets—do they return?
R. W. Earp, Construction of a planisphere.

December: W. K. Robertson, Merton's method for the determination of comet orbits.

Officers (from July 1949): President, W. H. Robertson; Hon. Sec.-Treas., J. H. Catts (Box 3989, G.P.O., Sydney); Editor, W. H. Robertson; Asst. Editor, E. M. Mitchell; Librarian, W. H. Wood; Asst. Librarian, G. Frankum.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

Recombination of Characters between Two Influenza Virus Strains

In the course of experiments on the encephalitis produced in mice by the 'neuro' variant of the influenza-A virus strain-WS (Stuart Harris, 1936) we had occasion to study the interference produced by simultaneous inoculation of neuro-WS with other non-encephalitogenic strains of influenza virus. Well marked interference was observed as has already been noted by Vilches and Hirst (1948). From mice in which symptoms were delayed but not prevented by the interfering virus we have on several occasions isolated virus strains which appeared to combine the characters of the two types used as inocula.

The principal markers which we have used to characterize the strains are (*i*) serological character as judged by antihæmagglutinin titrations with ferret antisera, (*ii*) heat stability of hæmagglutinin (62°C for 30 minutes), (*iii*) capacity to produce fatal encephalitis in mice on intracerebral injection. Table 1 shows the characters of the original strains: neuro-WS (Stuart Harris), NWS, a mouse lung strain of WS, WSM, and the Shope strain of swine influenza virus, SW.15, and of the two types of 'recombinant'. Four examples, each from a different mouse inoculated with primary mixtures of NWS and WSM, have been obtained of the first type of recombinant, but to date only one of the NWS-SW.15 combination.

Table I.
Apparent Recombination of Characters in Influenza Viruses.

Strain	*Serological type*	*Heat Stability (62°C, 30 min.)*	*Neurotropism*
NWS	WS	(54°C)	+ (6667)
WSM	WS	+ (67°C)	—
SW15	SW		—
NWS / WSM	WS	+ (66°C)	+ (6668)
NWS / SW15	SW		+ (5566)

Heat stability +, hæmagglutinin present; temperature shown at which titre reduced to less than 1%.

Neurotropism +, mice killed on intracerebral inoculation, figures show days of death after inoculation of 1:100 dilution.

In order to show that we were not concerned with mixtures but with pure clones of a new type of virus, each of the five strains has had at least two passages at limiting infective dilution in chick embryos. For each it has been shown that when a series of eggs is inoculated with a dilution of virus about the 50% infective level so that both positive and negative fluids are obtained, all the positive fluids show the relevant marker characteristics. Further evidence against any suggestion of virus mixtures is provided by the fact that each of the two recombinant types has

at least one quality which is not shown by either parent strain. NWS-WSM is further to the right of the receptor gradient (Burnet, McCrea and Stone, 1946) than either NWS or WSM; neuro-SW does not elute from fowl red cells. It should also be added that no strains with the characters of the recombinants were present in the laboratory (or have ever been described by others) so that no question of casual contamination can arise.

It is believed that these findings offer a real analogy to the situation described for bacterial viruses (Delbruck and Bailey, 1946; Hershey and Rotman, 1948; Delbruck, 1949) and that the study of the conditions under which recombination occurs may throw important light on the processes of intracellular virus multiplication. A full account of these experiments will be published elsewhere.

F. M. BURNET.
P. E. LIND.

The Walter and Eliza Hall Institute of Medical Research,
Royal Melbourne Hospital,
Melbourne.
December 1949.

References

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A Rotating Dialyzer of Variable Capacity

IN the study of macromolecules, such as proteins and polysaccharides, it is sometimes necessary to remove small molecules and ions by dialysis. An apparatus which has been used for such a purpose in this laboratory is shown in Figure 1. The stainless steel tank A, 36 cm. wide, 45 cm. deep and 47 cm. high, is fitted with the wire frame B to hold the dialysis tubes. The frame is cubic in shape, with 27 cm. sides and 3 cm. spacings between the stainless steel wires. A 1 cm. wire-mesh grid covers one face; a similar grid C, which is hinged along one edge and may be fastened against the face of the frame by means of a clip D, serves as a lid on the opposite face. The wire frame is rotated on an axis at 14 r.p.m. by the motor G, operating through the reduction gear H. Water enters at E and issues from perforations in a tube which encircles the inside of the tank near the bottom. It overflows at F.

The solution is dialysed in tubes each 42 cm. long, 2·7 diameter, prepared by knotting one end of a length of regenerated cellulose tubing. After the solution is added, the tube is closed by a second knot and the free end is twisted around one of the horizontal wires at the top, so that when the lid is closed the tube is held at one end. Water is then admitted, and when the tank is full the motor is switched on. The movement of air from one end of the tube to the other during rotation thoroughly mixes the contents; this, together with the vigorous flow of water through the tank at approximately 8 litres per minute,

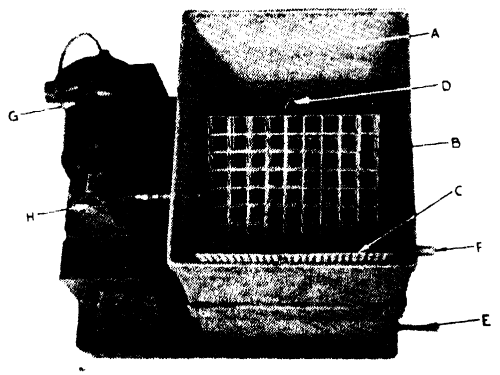

Figure 1
View of dialyzer showing the rotating tube carrier with the lid open.

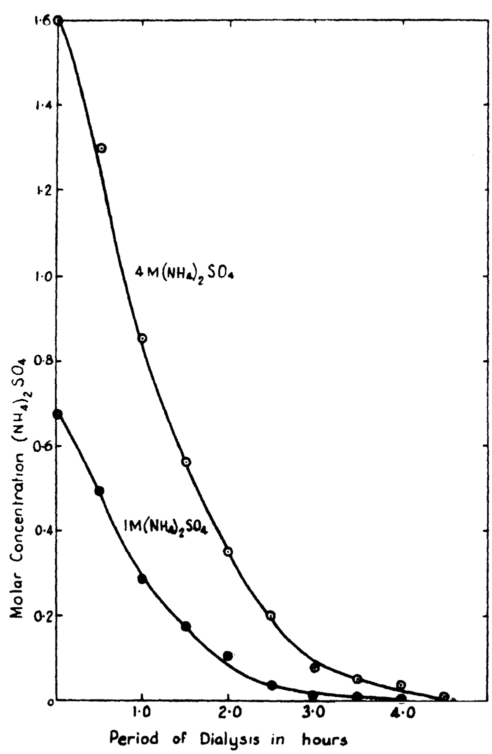

Figure 2
Reduction in concentration of 4·0M and 1·0M$(NH_4)_2SO_4$ solutions during dialysis.

ensures rapid transfer of diffusible materials through the walls of the tubes.

Quantities of solutions up to 8 litres can be dialysed in the apparatus, according to the number of the 81 compartments used and the volume of the solution placed in each tube. The maximum volume of solution which may be safely treated in each tube depends upon its concentration. When highly concentrated solutions are used, the rapid entry of water causes distension of the tubes, and may cause them to burst either before or during withdrawal from the apparatus. When 100-ml. portions of 4·0M ammonium sulphate were dialysed at 11°C, the volume increased to a maximum value of 230 ml. in 2·5 hr., whereas 100-ml. portions of 1·0M ammonium sulphate increased only to 150 ml. in 4·0 hr. Removal of tubes containing originally 100-ml. portions of 4·0M$(NH_4)_2SO_4$ from the apparatus at half-hourly intervals, dilution of the contents to 250 ml., and estimation of the salt content, revealed progressive reduction in concentration as shown in Figure 2. A similar experiment with 1·0M$(NH_4)_2SO_4$, in which the solutions were diluted to 150 ml. after dialysis, is reported in the same figure. The results indicate that a period of 4·5 hr. was sufficient to reduce the concentration of ammonium sulphate to less than 0·01M in both experiments.

The work described in this paper forms part of the research programme of the Division of Industrial Chemistry, Commonwealth Scientific and Industrial Research Organization, Australia.

F. G. LENNOX.

Biochemistry Section,
Division of Industrial Chemistry,
C.S.I.R.O., Melbourne.
25 August 1949.

Colorimetric Determination of H_2O_2

IN an attempt to do away with the permanganate titrations involved in most methods of catalase estimations, a colorimetric method of determining hydrogen peroxide was sought unsuccessfully in the literature.

The yellow colour developed by quadrivalent titanium in the presence of hydrogen peroxide, first observed by Schoenn (1870) was used by Weller (1882) as the basis of a colorimetric method of estimating Ti. It has been found that a method for peroxide estimation can be developed from this by keeping the Ti concentration constant, the molecular proportions of Ti to hydrogen peroxide being at least 25:1. The intensity of the colour is independent of the acid concentration, but depends on that of Ti. Using 0·05M Ti in 4N.H_2SO_4 the colour intensity obeys Beer's Law, and is reproducible within 1%. After half a minute it is stable for 24 hours, and organic matter in concentrations met with in catalase estimations has not been observed to cause it to fade for over an hour.

The procedure adopted is to add 1 ml. of a solution containing less than 0·01M H_2O_2 to 5 ml. of Ti^{IV} (0·05M) in 4N.H_2SO_4, reading the colour with a blue filter (Wratten No. 47 or Ilford Tricolour) on an electric colorimeter or at 500 mμ on a spectrophotometer, standardizing on 5 ml. reagent plus 1 ml. distilled water.

The lowest concentration of peroxide that can be estimated with reasonable accuracy is about 0·0005M (in 1 ml. unknown) using ⅝-inch cuvettes.

J. F. HUMPOLETZ.

Faculty of Agriculture,
University of Sydney.
1 November 1949.

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Isolation of a Ketose from a Mixture with an Aldose

IN the course of an investigation, a solution was obtained containing a mixture of aldose and ketose. The possibility suggested itself of removing the aldose by oxidation with hypoiodite; the method, of course, has been extensively employed for the estimation of aldoses,* but there appears to be no record of its use for the isolation of a ketose from a mixture with an aldose.

We tested the method in the following manner. 25 ml. of 0·1N iodine solution and 5 ml. of 2N.NaOH were added to a solution of 50 mg. galactose and 50 mg. fructose in 2 ml. of water. After standing in the dark for 30 minutes, 4 ml. of 17N acetic acid were added, and enough solid sodium sulphite then added to reduce the free iodine. Then 0·4 ml. of phenyl-hydrazine was added and the solution was heated in a boiling-water bath for 30 minutes. The osazone obtained on cooling melted in the crude state at 200°C and recrystallizations from alcohol raised it to 203°C. A mixed m.p. with an authentic specimen of glucosazone was not depressed.

Using this method with 75 mg. of a mixture of aldose-ketose, the ketose was isolated at the phenylosazone m.p., 155°C (twice recrystallized). This did not depress the melting point of an authentic specimen of d-sorbose-phenylosazone, m.p. 153°C. Mixed m.p., 153°C.

It appears that by the above method a ketose can be identified as an osazone after the removal of admixed aldose with hypoiodite.

C. M. MARTIN,
F. H. REUTER.

Chemistry Department,
Sydney Technical College.
November 1949.

* For a detailed discussion see GREEN, J. W. (1948): *Advances in Carbohydrate Chemistry*, 3 (New York), and BROWNE and ZERBAN (1941): *Sugar Analysis*, 3rd Edition, 895ff. (New York).

The Hawkesbury Sandstone as a Soil Parent Material

THE letter by N. C. W. Beadle and N. A. Burges, 'Working Capital in a Plant Community' (This JOURNAL, *11*, 207) calls for comment concerning the potentialities of the Hawkesbury Sandstone as a soil parent material. While it is true that this sandstone appears to consist largely of quartz sand, it actually has a variable composition and in places has interbedded bands of shale or shale lenses.

G. D. Osborne, in his presidential address to the Linnean Society of N.S.W. in 1948, quoted a number of analyses of the Hawkesbury Sandstone, and from these it is seen that although much of it consists of 80% to 90% SiO_2, it also contains appreciable amounts of Fe, Mg, Ca, Na, K. Ti, and P. The cementing agents noted are siderite (ferrous carbonate), kaolinite and other clay minerals, micaceous minerals such as sericite and chlorite, barite (barium sulphate), and silica. The Na, K, and Ca are probably present, with alumina, as felspars, but the source of Mg is not so apparent, although a small amount of biotite mica has recently been found and hornblende and pyroxene have been recorded as detrital grains.

Even small quantities of any chemical in a rock amount to appreciable quantities when the mass of that rock is considered; thus in a sandstone with 91·44% SiO_2 (the most siliceous of the analyses quoted) we have:

	Percentage	*lb. per acre-inch rock (approx.)*
Al_2O_3	4·41	2,643
Fe_2O_3	0·50	300
FeO	0·18	108
MgO	0·18	108
CaO	0·34	204
Na_2O	0·04	24
K_2O	0·60	359
TiO_2	0·52	312
P_2O_5	0·01	6

It is probable that leaching is much more effective in a porous rock like the Hawkesbury Sandstone than in other types of rock. A mineral which could be used as a gauge of this leaching is ilmenite ($FeTiO_3$) which changes under acid conditions to authigenic rutile (TiO_2) and anatase (TiO_2), which are easily distinguished microscopically from the same minerals in the detrital form.

DOROTHY CARROLL.
Linnean Society of N.S.W.
10 October 1949.

A Note on Graticule Blank Manufacture

THE surfaces of the graticule blanks used in all but the most elaborate optical instruments need not be accurately parallel, and a device known as a 'spider' may be used in their manufacture. The degrees of flatness and parallelism obtainable by this technique are discussed, and its general advantages outlined.

In the figure, a batch of blanks is shown with their surfaces projecting above that of the spider, which is a thin disc fitted with circular apertures of diameter approximately 1 mm. greater than that of the blanks. The blanks are supported by a flat tool fixed to the spider with luting or pitch, with an intermediary layer of a durable paper or cloth added for the polishing operations. Suction enables the tool to be manipulated without the blanks being dislodged; the rubber cup shown in the figure is used to lift them from the tool. A number of materials have been used successfully in the construction of spiders, namely copper, brass and perspex; of these, copper has been found the most satisfactory.

The grinding and polishing operations are performed in the usual manner; the surfaces are polished with cloth, wax or pitch, depending on the requirements, pitch being used for maximum flatness and parallelism, although the results obtained are less affected by variations in surfacing technique than when the blanks are blocked. The chief advantages of the spider are that considerable time is saved by the elimination of the blocking processes, and the risk of contamination with the previous abrasive is reduced by using a different tool and spider for each stage of the grinding and polishing. In addition, the blanks can be removed for inspection and any blank inverted or removed from the batch when its surface is satisfactory.

The flatness and parallelism obtained are dependent on the conditions of grinding. It is most important that blanks of approximately the same thickness be placed in the spider, otherwise uniform grinding will not take place until the thickest blanks have been reduced and even then the best results are not obtained. Experiment shows that spiders of diameter not less than 15 cm. should be used. Under these conditions, with pitch or a reasonably rigid cloth or paper as polisher, it is possible to produce blanks with surfaces flat to within four fringes to the inch and parallel to within one or two minutes of angle. Blanks of this quality are adequate for the graticules of most optical instruments and have been used in the graticules constructed in the Physics Department of the University of Sydney for use in laboratory and service equipment.

G. A. HARLE.
Department of Physics,
University of Sydney.
3 August 1949.

Views

Training of Geologists

I WAS interested to read the summary of the discussion on training in geology and geophysics which was published in This JOURNAL, *11* (1949), 199.

In September last year a Specialist Conference on Geology and Mineral Resources was held in London. One of the items discussed at that conference was the question of training and recruitment of geologists for service in official geological surveys throughout the British Commonwealth. There were present at this conference representatives of geological surveys from the United Kingdom, the Dominions and the Colonies, and I think the conclusions of these people, which are summarized in the following extract, are well worthy of notice:

> There was general agreement on the broad principles which should be followed in training and recruitment of geologists for service in official Geological Surveys throughout the Commonwealth.
>
> It was also agreed that, while it was desirable that geologist recruits to most Colonial and Dominion Surveys should receive training in special techniques (e.g., photogeology and surveying) prior to taking up duty, the primary consideration in University courses for geologists should be sound training in geological concepts and principles with supporting courses in fundamental science, for example, chemistry, physics and biology.

H. G. RAGGATT.

Bureau of Mineral Resources,
Geology and Geophysics,
Department of Supply and
Development,
Melbourne.
14 October 1949.

Programmes for Science Congresses

CONGRESSES have now become a feature of present existence and we hear daily of this person and that leaving for, talking at, and returning from, one congress or another. Without doubt something is generally achieved at such affairs, even if later rendered ineffectual by neglect or just plain cussedness. Moreover, the delegates are probably all the better for the change from their usual work and they do meet with fellow workers and benefit from discussion of problems with them.

Such conferences are only really useful, however, when there has been clear definition of the subject to be discussed. When our Science Congresses began, in 1888, the various fields of science had not expanded to such an extent that a general picture of advances could not be reported on and co-ordinated during the congress. Nowadays the diversity within a science makes it quite impossible for the *whole* science to be reviewed at any congress. Moreover, the sections usually recruit papers on any and every aspect of their science. The result is chaos: a paper on feeding habits in the housefly follows one on the distribution of colour variants in snakes and is followed by another in the homologies of the epipubic bones!

The specialization that has been forced on scientists, though deplorable, is inevitable; the anatomist is little interested in the work of the economic entomologist or the ecologist. Is there a solution? Something could be done by planning section programmes so that the meetings were all concerned with some particular subject, all possible aspects of it receiving attention. At the last congress in Hobart, Section I+N worked on such a plan, and the results were excellent. Most of the other sections organized one or more half-day or full-day symposia, but apart from these much effort was wasted.

What would be the results of such specialization? Firstly, subjects could be dealt with widely and reviewed generally, and this would be of considerable benefit to the specialists working within the subject. The sections would choose different topics for each congress and the prime concerns would come up for review and discussion at frequent intervals.

Secondly, workers in a particular field would be more likely to attend a congress at which their subjects formed a major part of the proceedings of their section, than one at which only one or two relevant papers were being presented. It is particularly important in these days to halt the closing-off of specialists into small cells, and it is therefore desirable to widen their views of their own subjects at least. It is also obvious that workers in governmental departments and in industry are more likely to be able to attend discussions at which their subjects are featured, than the general hotch-potch of our congresses.

N. J. B. PLOMLEY.

Queen Victoria Museum,
Launceston.
September 1949.

Reviews

Agriculture

FARM WORK SIMPLIFICATION. By L. M. Vaughan and L. S. Hardin. (New York: John Wiley; London: Chapman and Hall, 1949. 145 pp., 49 text-figs. and photos. $5\frac{1}{2}'' \times 8\frac{1}{2}''$.) Price, $2.80.

The application of time and motion studies has become widely used in engineering and industrial operations. This book indicates how the same techniques can be applied in the simplification of practically all phases of farm work. It is, in the main, a compilation

of the experiences, methods and results of farm work simplification studies carried out by research workers either as part of the National (U.S.A.) Farm Work Simplification Project (created in 1942) or independently.

While text-books in Agricultural Economics and courses in agricultural colleges do cover, in a general way, such aspects of farm management as the 'economics of labour', this book appears to be the first devoted exclusively to a detailed treatment of farm-work simplification. It is divided into two parts, of which the first discusses the place of work simplification in farming, under the headings: What Farm Work Simplification Is; What Savings Can be Made; The Principles of Effective Work; How Results May be Used. The second part describes methods and plans that may be used in making a research study of work operations or in teaching the principles and procedures of work simplification. Emphasis is placed on 'product analysis', 'man analysis—time and travel', 'man and machine analysis', 'film analysis—body motion'.

Farmers who may be considered as efficient in working out their problems from their own 'experience and commonsense', will be surprised to notice the discrepancies which trained observers bring to light. Certainly the authors offer practical suggestions of labour-saving methods which might well be used.

The book is well arranged, well printed on good paper, and has an average of one figure to three pages. In addition to a liberal assignment of interspersed quotations and footnotes, the authors provide, at the end of each chapter, a list of references for further reading. It may be recommended to farmers, extension workers and teachers of agriculture; and as a reference book for agricultural colleges.

E. A. Southee.

Biochemistry

The Chemistry and Technology of Enzymes. By Henry Tauber. (New York: John Wiley and Sons; London: Chapman and Hall, 1949. 550 pp., 56 text-figs., 63 tables.) Price, $7.50.

Tauber has previously written two books, *Enzyme Chemistry* and *Enzyme Technology*. This new volume was designed to supersede them, at the same time expanding and revising the contents. About one half of the space is devoted to a summarized survey of the main enzymes, well supplied with references to the important literature and including some very recent material. This section is an excellent introduction to enzyme chemistry.

The technology section contains chapters on the most important industrial uses and methods of production of enzymes. The production of antibiotics and enzymes for medicinal use is also considered. A useful addition to the new volume is a chapter on the microbiological methods for the estimation of vitamins and amino-acids.

Tauber has provided the best single-volume collection of information on enzymology available at the present time both for the student in the class laboratory and the graduate in the food and fermentation industries. It is clearly presented and well indexed.

J. L. Still.

Botany

Fungi and Plant Disease. By B. B. Mundkur. (London: Macmillan, 1949. 246 + x pp., 130 text-figs. and photos. $5\frac{3}{4}'' \times 8\frac{3}{4}''$.) English price, 16*s*. net.

This text was written for Agriculture students of colleges and universities in India. It may be used with advantage in Australia, however, as an introductory text on fungi, and as a text on fungal diseases of crops that are grown in New Guinea and northern parts of Australia.

In view of the non-existence of a suitable introductory text on fungi for Agriculture students, this book might well fill that need. It contains a clear and accurate, though formal, account of the morphology and reproduction of the fungi, defining the multiplicity of technical terms associated with mycological studies. Each section, of the chapters dealing with the diseases caused by genera of pathogenic fungi, begins with a treatment of the purely mycological aspects of the genus, and each chapter begins with a mycological description of the class, sub-classes, orders, and families of pathogenic fungi.

Following on this mycological discussion there is an account of the diseases in India caused by species of each genus. Since Sir Edwin Butler's excellent publication, *Fungi and Disease in Plants*, is now out of print, this text supplies a useful and up-to-date account of the fungal diseases of crops grown in India. It is obviously influenced by Butler's publication and contains many illustrations from his text. The book is well illustrated; the illustrations of symptoms of disease are mostly photographs and are good on the whole.

The chapter on 'Metabolic Processes in Fungi' is disappointing and too brief to be of much value. It would have been more appropriate to have called the chapter 'Physiology of the Fungi', because it contains mostly physiology and very little that could be called metabolism. Again, the chapter on bacterial diseases, and the chapter on virus diseases, are not up to the standard of the remainder of the book. It is noted with regret that the generic terminology of *Phytomonas* is used. It would be preferable that texts on fungal diseases adhere strictly to fungi and do not include bacteria and viruses. The last chapter, on disease control, is a good modern summary of this aspect of pathology.

N. H. White.

Chemistry

LABORATORY OUTLINES AND NOTEBOOK FOR ORGANIC CHEMISTRY. Second Edition. By C. E. Boord, W. R. Brode and R. G. Bossert. (New York: John Wiley; London: Chapman and Hall, 1949. 282 pp., 33 text-figs., tables. 6½″ × 9″, card covers, loose-leaf spring binding.) Price, $3.00.

A LABORATORY BOOK OF ELEMENTARY ORGANIC CHEMISTRY. Third Edition. By A. Lowy and W. E. Baldwin. (New York: John Wiley; London: Chapman and Hall, 1949. 186 pp., 75 text-figs., one plate. 7″ × 9¾″, card covers, loose-leaf spring binding.) Price, $3.00.

Since both of these books have the same purpose and have many features in common, it is convenient to review them together. Each is intended to supplement and illustrate a concurrent lecture course in elementary organic chemistry, commencing with purification and analysis and then working through the chief aliphatic and aromatic compounds in the conventional order; and at the same time to give practice in the common laboratory techniques.

They are not only text-books of practical organic chemistry, but also—since spaces are provided in and after the experimental instructions for the student to write in equations, yields, etc., and for the supervisor to mark or check the work—they are practical notebooks. In addition, a set of questions on the experiment itself, and on related topics, is given after each exercise, with spaces for answers. A wire spiral binding and perforated pages allow the removal of any page without damaging the others.

After adequate introductions dealing with general laboratory practice and first aid, the courses proper follow. These are not of equal length. Boord, Brode and Bossert's course consists of nearly 80 exercises, but Lowy and Baldwin's has only 42. The latter comprises the usual elementary preparations and tests, with some bias towards aliphatic chemistry in accordance with recent American industrial trends; but the former introduces in addition some experiments of a novel type, which should appeal to most students since they deal with useful everyday substances such as D.D.T. and nylon. Another useful and pleasing feature of this course is the incorporation of exercises on the construction of molecular models and on nomenclature. Surprisingly, neither course includes anything on tautomerism, but otherwise they are well balanced. The instructions in each exercise are lucid and detailed and could scarcely be misunderstood by any student. Clear diagrams of apparatus are included where necessary, and Lowy and Baldwin's book also has numerous diagrams and pictures of industrial equipment. Whilst these do help to familiarize the student with such equipment, it seems to the reviewer that too much space, which could have been better utilized, is devoted to them.

In general, the questions appended to the exercises are pertinent and should make the student appreciate the reasons for each step in a preparation. The number of questions varies, of course, according to the particular exercise. In Boord, Brode and Bossert's book the average would be about five, but in Lowy and Baldwin's it would be close to twelve, which seems to be carrying a good idea too far.

A feature present in Boord, Brode and Bossert's book, but lacking in the other, is the theoretical discussion preceding each exercise. These are admirable. The reaction is concisely and clearly explained, generalized, and correlated with allied reactions.

The combination of text-book with note-book in these thoroughly organized courses should make it easy to handle large classes efficiently. One adverse criticism on this point may be made: it becomes unnecessary for the student to write a description of his own work in his own words. Anyone with teaching experience will agree that extensive practice in writing reports is highly desirable for all students. On the whole, however, both books are to be highly commended.

E. RITCHIE.

Crystallography

CRYSTALS AND X-RAYS. By Kathleen Lonsdale. (London: G. Bell and Sons, 1948. 199 pp., 13 plates, 138 text-figs. 5½″ × 8½″.) English price, £1. 1s.

This book deals essentially with what might now be termed Pure X-Ray Crystallography; that is, determination of the distribution of atoms and electrons in crystalline material. It leads smoothly from quite elementary topics of the properties of X-rays and the symmetry of crystals to quite advanced applications of those principles to structure analysis. This is quite a large programme for a relatively small book, and some parts inevitably are traversed without much attention to detail. Thus anyone who desires to work in this field will need to obtain more information on experimental techniques, without which it would be impossible to obtain diffraction photographs of the high standard that, for instance, characterizes the illustrations in the book.

In addition, he will need more detailed information and experience of the mathematical techniques that are required in deducing the electron distributions from the X-ray diffraction effect. This is especially so now that the emphasis in pure X-ray Analysis has passed from the simpler structures of earlier work to the considerably more complex organic structures in the biological field, where the solution of the penicillin and haemoglobin structures represents typical recent triumphs.

The book is of special interest because Dr. Lonsdale has included a chapter on the diffraction effects arising from imperfections in crystals and from thermal vibration of the atoms, to the study of which she herself has contributed so greatly. There is also a final chapter on applied X-ray analysis, which nowadays looms largely in chemistry and metallurgy; but the main theme as already indicated is pure Structure Analysis. As an all-round introduction to this subject the book is one of the best so far written, and one that will be found most useful to both lecturer and student.

W. A. Wood.

Entomology

Principles of Insect Pathology. By E. A. Steinhaus. (New York: McGraw Hill, 1949.)

The early history of the use of micro-organisms to control insect pests is an account of many failures. Perhaps the best known attempt to use a bacterial organism was d'Herelle's effort from 1910 to 1912 to control locusts in Mexico and South America. Subsequent workers failed to repeat the early apparent successes, and the methods were subsequently abandoned. Similarly, with the attempted control of chinch bug, corn borer, and other insects, after showing early promise, the methods were discarded. But in the last few years, with improved techniques, increasing attention has been given to this phase of insect control, and renewed confidence in the method is emerging. Thus American workers have used 'milky disease' bacteria to assist in the control of the Japanese beetle; Canadian workers have successfully introduced a virus attacking the destructive spruce bud worm into Newfoundland; and quite recently experiments in California have suggested that control of the alfalfa caterpillar may be possible using a virus causing a wilt disease.

These successes are focusing increasing attention on the field of insect pathology. It is, therefore, particularly opportune that the scattered literature on this subject has now been brought together by one of the most active contributors to the science. The high standing of the McGraw-Hill Publications in the agricultural sciences has been maintained in this, the latest addition to the already considerable list. The author, Associate-Professor E. A. Steinhaus of the University of California, has rendered a valuable service to applied entomologists, students, and research workers, and has written a much more readable work than his earlier *Insect Microbiology* (1946). The volume is of excellent format, well printed, and illustrated with 219 figures. The author is at his best in the specialized chapters dealing with the bacterial, fungal, and virus infections of insects. In these, truly critical discussions of many controversial points are presented. For example, he divides the viruses pathogenic to insects, included under Holmes's Borrelinaceae, into four genera—*Borrelina* Paillot, *Paillotella* gen. nov., *Bergoldia* gen. nov., and *Morator* Holmes.

It is of interest that the subject of insect pathology should have been so thoroughly treated while there is still no detailed data on what constitutes a 'sick' insect, and it is significant that the chapter on Symptoms and Pathologies is the only one without references. Likewise histopathology is discussed in some detail while no compilation or even review of normal insect histology is available.

Interesting historical sidelights of the subject are discussed, as Pasteur's work on silkworm diseases. Perhaps of greatest importance, the role of micro-organisms in the gigantic problem of insect control, is placed in perspective. Steinhaus shows that the field has hardly been properly examined. He concludes that in some instances the dissemination of insect pathogens may have a place in biological control. The whole work is fully documented (with about 1000 references) and is essential for any entomological library.

M. F. Day.

Geology

Submarine Geology. By F. R. Shepard. (New York: Harper Bros., 1948. 338 pp., 106 text-figs.) Price, $6.00.

This is the pioneer text-book in English on a subject in which the author has long been active. He has investigated in detail the offshore features of the north-eastern and south-western coasts of the United States, and recently for military purposes made a close study of the charted features of coastlines throughout the world. Chapters on the history of the science, its methods of investigation, and the characteristics of waves and currents, are followed by a new genetic classification of coasts which avoids the inadequacies inherent in that based on emergence or submergence as used in the majority of text-books. A chapter on beaches and sand-movements along the shore deals with the (usually annual) cycles of cut-and-fill beach-formation, the source and permanent losses of beach-sand, and erosion by tsunamis.

This is followed by a world-wide summary of shelf-topography. Under the headings 'Some Debunking and Some Statistics' and 'More Debunking and Some Generalizations', the author then shows that the traditional concept of the continental shelf—as a deltaic wedge of terriginous materials margined by the continental slope, with sediments on its smoothly-sloping upper surface becoming finer in grain-size with increasing distance from the coast—can no longer be accepted as being even approximately valid. The shelves in general do not have smoothly-sloping graded surfaces, but are terraced, irregular and extremely

variable. The sediments thereon do not usually show a progressive seaward decrease in grain-size. Vast areas of the shelf have rock bottom or current-swept gravel bottom, and such areas are as common along the outer margin as in any other portion. The average depth where the greatest change of slope occurs—the shelf margin—is at 72 fathoms rather than the traditional 100 fathoms; and sags 10 fathoms deep frequently occur below the general level of the shelf. Sea-levels have been very unstable during much of past time, as a result of the waxing and waning of continental glaciers. The present sea level does not date back more than a few thousand years, and the sediments on the shelf are in general coarser than those now being deposited. Shelf-cutting at various levels must be visualized during Pleistocene times, and the repeated building of deltas. Special features characterize shelves formerly swept by glaciers.

The account of continental slopes leads on to a discussion of the characteristics and origin of submarine canyons which in great numbers dissect continental slopes and the outer portions of continental shelves. They are cut at times through the covering sediments into hard, well-consolidated pre-Pleistocene formations, or even granite, and show such features as V-shaped cross-section and gravelly floors, which seem to be inexplicable by any of the suggested methods of formation other than sub-aerial erosion. The last would, however, necessitate oscillations of sea level during Pleistocene times much greater than those which were visualized by Daly and which are widely accepted as explaining the features of coral reefs and atolls. The author, accordingly, is inclined to give more weight to extensive Darwinian subsidences (rising sea levels) than to the limited sea-level oscillations of Daly's hypothesis, and draws support for his view from recent studies of the Bikini atoll and elsewhere. The conclusion involves necessarily great changes in current conceptions of the major phenomena of crust-movement during Cainozoic times, and must receive widespread consideration from many aspects of fundamental importance.

The book concludes with a discussion of the nature of the sediments on the floor of the ocean, and of its general form, which, as a result of the recent extensive use of sonic sounding, proves to be much less uniform than was formerly thought to be the case. (In the recently issued U.S. Hydrographical Office bathymetrical chart of the north-western Pacific, H.O.5485 Korea to New Guinea, 95 per cent. of the soundings utilized were obtained by sonic fathometers.) Consideration is given to various hypotheses of the origin of the ocean basins and their floor irregularities, and to that of the formation of arcuate island chains and the associated deeps, with reference to the work of Vening Meinesz.

This very informative and thought-provoking work thus points out the apparent contradictions involved in the data now available, and the consequent need for much further investigation. 'Whatever we find, the indications are that something has been radically missing from our knowledge of past geological conditions.'

W. N. Benson.

Mathematics

An Introduction to the Laplace Transformation. By J. C. Jaeger. Methuen's Monographs on Physical Subjects. (London: Methuen, 1949. 132 + viii pp., 31 text-figs., 2 tables. $4\frac{1}{4}'' \times 6\frac{1}{2}''$.) English price 7*s*. 6*d*. net.

Dr. J. C. Jaeger has established for himself a world reputation for his work on the Operational Calculus, both in conjunction with Professor H. S. Carslaw and independently. As might be expected, the work under review is a very worthy addition to the series of Methuen's Monographs on physical subjects. The book will be especially interesting to Australians in so far as it incorporates a course of lectures Dr. Jaeger gave to engineers and physicists at the National Standards Laboratory in Sydney in 1944.

The book is concerned with the solving of physical and engineering problems in which the function or functions to be found satisfy given differential equations and given initial conditions. Inside the 25 pages of the first chapter the author sets down with adroit selection the main points of importance needed in applying the Laplace transformation to cases of ordinary differential equations. The theory is most readable because the author states in simple English the essential significance of each step.

Later in the book the case of partial differential equations is discussed. A refreshing feature is that the author tells the reader explicitly where he stands on points of rigour. Only a prior knowledge of the calculus is assumed, but it is pointed out where complex variable theory is needed for a fully rigorous account. After the first chapter, the bulk of the book is devoted to applying the theory of transient problems in engineering and physics, and the text is enlivened with a variety of problems, both worked and set.

It is hard to imagine how Dr. Jaeger's work could be bettered as a short introduction to the use of the Laplace Transformation.

K. E. Bullen.

Radiochemistry

Introduction to Radiochemistry. By G. Friedlander and J. W. Kennedy. (New York: John Wiley; London: Chapman and Hall, 1949. 399 pp.) Price, $5.00.

Though terms like 'radiochemistry', 'nuclear', 'tracer' and 'radiation chemistry' are coming into increasingly wide use, their precise mean-

ings have not yet become clearly fixed and it is important, therefore, to know in what sense Friedlander and Kennedy use the term radiochemistry. They say: 'To our minds nuclear chemistry emphasizes the reactions of nuclei and the properties of resulting nuclear species, just as organic chemistry is concerned with reactions and properties of organic compounds. We think of tracer chemistry as the field of chemical studies made with the use of isotopic tracers, including studies of the essentially pure tracers at extremely low concentrations. In the title of this book we have meant the term radiochemistry to include all the fields just described, but to exclude stable-isotope tracer applications. Radiation chemistry, which is not discussed in this text, deals with chemical effects produced by nuclear and other like radiations and, although it involves some of the phenomena of radiochemistry, it is really closely related to photochemistry.

One's first impression on reading the book is that it gives undue emphasis to purely physical matters. By far the greater part of the book (the first ten chapters in fact) are devoted mainly to the phenomena and measurement of radioactivity. Only the last three chapters are devoted to subjects like the identification, concentration and isolation of radioactive species, chemistry of low concentrations and tracers in chemical applications. This seeming lack of balance may be justified on two counts. Firstly, the larger part of the book does provide the indispensable foundation for the proper understanding of the application of radioactivity to chemistry. Secondly, though complete in itself, this book will evidently be found most useful in conjunction with a companion volume, *Radioactivity Applied to Chemistry*, edited by A. C. Wahl, to be published later.

Friedlander and Kennedy have given a most useful and clearly written account of a field in which advances are extremely rapid: an account which will therefore be most welcome to students and research workers alike. Each chapter is followed with a set of instructive exercises and references to more specialized publications. Another valuable feature of the work is a very extensive table (covering nearly 100 pages) of data concerning radioactive and stable isotopes of the elements. The book itself is excellently produced.

D. P. MELLOR.

ISOTOPIC CARBON. By M. Calvin, C. Heidelberger, J. C. Reid, B. M. Tolbert, and P. E. Yankwich (New York: John Wiley; London; Chapman and Hall, 1949. 376 pp., 107 text-figs. and bibliography. 6″ × 9″.) Price, $5.50.

An interesting history of science could be written largely in terms of the discovery and development of new techniques and instruments. Should such a history ever be written, the discovery and use of radio-isotopes will occupy a prominent chapter. There is now little doubt that radio-isotopes promise a vast extension to the whole of chemistry. Since carbon compounds occupy such a large part of the subject, the ready availability of radio-isotopes of carbon is an event of the first importance.

The introduction of a new technique is sooner or later followed by such a tremendous flood of activity that attempts to consolidate progress, made by bringing together accounts of the experience of many investigators such as the one under review, are most useful. The first radio-isotope of carbon studied (C^{11}), though very useful from some points of view, had one serious limitation, namely its short half-life (20 minutes). Not a great while after the discovery of C^{11}, much longer-lived C^{14} (half-life 5100 years) became known. As produced in the cyclotron by the deuteron bombardment of ordinary carbon enriched in C^{13}, the long-lived isotope C^{14} was prohibitively expensive. Today, fortunately, C^{14} is readily produced in the uranium pile by the slow neutron bombardment of ammonium nitrate, and sells for something like $50 a millicurie. Scores of carbon compounds containing C^{14} have already been produced.

Convinced that isotopic carbon, in the form of C^{11}, C^{13} or C^{14}, will soon find a place as a routine tool in many kinds of scientific laboratories, the authors of this book, who incidentally are all members of the staff of the Radiation Laboratory of the University of California at Berkeley, have set out to produce a laboratory manual dealing with techniques of manipulation and measurement. This is essentially what the book is. It is claimed that every synthesis with isotopic carbon reported up to April 1948 has been described in detail sufficient to enable the book to be used directly as a laboratory guide; a claim which the reviewer has not tested but is ready to accept after a perusal of some of the descriptions.

Chapters are devoted to instruments and detectors for radioactivity measurement, sample preparation, synthesis of carbon labelled compounds, criteria of purity, degradation procedures and biosynthetic methods. There are ten very useful appendices dealing with such subjects as isotope dilution techniques, statistical treatment of counting data, and numerical examples illustrating radioactivity assay operations. No attempt has been made to describe all the manifold applications of isotopic carbon to tracer chemistry. The last appendix, however, contains a list of all the published applications of isotopic carbon up to July 1948. In regard to the main account, the manual has been fully documented. No investigator undertaking work with isotopic carbon can afford to be without this book.

D. P. MELLOR.

Book Notices

FOOD INVESTIGATION, 1947. D.S.I.R., Food Investigation Board. (London: H.M.S.O., 1949. 22 pp. 6″ × 9½″, paper cover.) English price, 6*d.*

This account of progress in food science is written for the non-specialist. Research on whale-meat showed that quality was improved if the whale were bled (by an incision in the neck) and the body cooled rapidly (by slitting the belly wall to circulate sea water). Research on meat included examination of arranging the time of *rigor mortis* from zero to 10 hours. Research was continuing on the spontaneous fermentation of concentrated orange juice; on the storage of potatoes in relation to air circulation; and on protective skin-coatings for apples. New methods were being developed for freezing and cold storage of herrings and lobsters, and for the production of oil and meal from herrings.

A list of 77 published papers is included.

ROAD RESEARCH, 1946 AND 1947. D.S.I.R., Road Research Board. (London: H.M.S.O., 1949. 57 pp., 8 plates. 6″ × 9½″, paper cover.) English price, 1*s.* 6*d.*

This is the first report of post-war research by the Road Research Board of the D.S.I.R.: the account of wartime activities is still to be published. The field of research, which previously included such matters as machinery, soils and pavements, has been widened to cover matters of road safety (such as headlamp dazzle) and traffic flow (including photography from the air). Collection and analysis of a considerable amount of miscellaneous statistical data is involved. There has been a significant extension of Information Service—including publications, research summaries, lecture courses, enquiries and visits, exhibitions and films, library facilities, and the admission of voluntary research students to laboratories.

CHEMISTRY RESEARCH, 1947. D.S.I.R., Chemistry Research Board. (London: H.M.S.O., 1949. 91 pp., 21 text-figs., 22 tables, 2 plates. 6″ × 9½″, paper cover.) English price, 2*s.*

The Chemistry Research Board of the D.S.I.R. has been organized into Corrosion, Inorganic, Organic and High Polymer Divisions, together with developments such as a Radiochemical Section and a Pure Metals Committee. There is indicated a considerable advance in liaison with chemical and allied industries.

Electrode potential measurements on painted steels have been supplemented by capacitance measurements which are sensitive for the detection of initial failure of the film. Microbiological studies have established that sulphate-reducing bacteria, responsible for corrosion of buried ferrous metals, are capable of autotrophic growth, being served with energy from molecular hydrogen.

Advances in the application of chromatography to inorganic chemistry have been achieved by the use of organic solvents in conjunction with solid adsorbents such as cellulose. A programme has been commenced for the determination of accurate physical and physico-chemical constants of organic substances, including the establishment of criteria of purity. It appears that acenaphthylene (from the dehydrogenation of acenaphthene) may be of significance in the plastics industry; work of significance is proceeding on organo-silicon compounds. Useful contributions have been made to fundamental knowledge of ion-exchange reactions using synthetic resins. An extensive programme is being undertaken on the analytical chemistry of uranium and thorium.

PEST INFESTATION RESEARCH, 1947. D.S.I.R., Pest Infestation Research Board. (London: H.M.S.O., 1949. 23 pp. 6″ × 9½″, paper cover.) English price, 6*d.*

This is the first report of the Pest Infestation Laboratory, which started in 1940, following a request from pre-war industry. The field of research was immediately enlarged because of the problems presented by wartime storage of large quantities of foodstuffs. This involved not only biological studies of insects and mites, but physical studies of bulk grain, etc. The carbon dioxide method was evolved for the estimation of the degree of infestation. Investigations were made of the dangers involved in silo fumigation and the effects of fumigant residues. Considerable work has been done on insect sprays and on means of applying them.

A PROSPECTOR'S HANDBOOK TO RADIOACTIVE MINERAL DEPOSITS. D.S.I.R., Geological Survey and Museum. (London: H.M.S.O., 1949. 28 pp. 6″ × 9½″, paper cover.) English price, 6*d.*

The pamphlet provides technical information necessary to guide prospectors, geologists and mining engineers. The British Government has guaranteed that over the next ten years it will purchase all high-grade uranium ore producible within the Colonial Empire, at a minimum price of £1540 per ton of contained uranium oxide, and will give grants towards production and extraction. World production was 600 tons a year in 1939, and is now certainly some thousands of tons. Millions of tons are known to exist in very low-grade deposits.

The pamphlet describes the common radioactive minerals, and the typical occurrences—supergene deposits of uranium, polymetallic lode deposits of uranium, pegmatites, carnotite deposits, placer deposits, other occurrences, and by-production from existing mines. It describes methods of test such as the Geiger-Muller counter, fluorescence tests, and photographic techniques. It gives details of the U.K. market and adds a Glossary.

DESCRIPTIVE CATALOGUE OF THE COLLECTION OF FIREARMS IN THE MUSEUM OF APPLIED SCIENCE OF VICTORIA. By E. H. Penrose. (Melbourne: The Trustees of the National Museums of Victoria, 1949. 161 pp., 14 plates. 6″ × 9″.) Price, 10*s.* 6*d.*

The collection contains 482 pieces, many of them given by W. E. J. Cole, of Frankston, in 1943. They range from blunderbusses of the early 18th century to machine guns of the recent war. The catalogue, which is intended primarily as a guide to the Museum, is arranged chronologically for each type. There is an appendix of 'Notable Gun Dates', a Glossary, a Bibliography, and an Index.

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(Continued from This JOURNAL, *11*, 222-3, June 1949.)

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Vol. 12 21 February 1950 No. 4

International Laboratories—I

THE conscious development of an international spirit and of international organization is a feature of our times. It has been of special interest to men of science, whose activities have ever been international in nature. World leaders whose task is to stimulate internationalism are finding that they look continually to science to show a way for other fields of human activity: while men of science are finding hopes of new progress which may follow from trends which seek to break down the political barriers that have restricted the material resources required for pursuit of science and have impeded the movement of personnel; and from trends which should breach some of the barriers of race and culture that have lain athwart the flow of information and ideas.

The ECOSOC Resolution

In October 1946 the French delegation to the Economic and Social Council of the United Nations submitted a proposal for the creation of international research establishments. It was stated that something more than the existing co-ordination of research activity was required in the general interests of humanity; that certain problems of pure and applied science would be more effectively attacked on a fully international basis, and that some could be solved only on such a scale. In relation to the direct aims of the United Nations, it was pointed out that the moral and intellectual development of small countries would be aided by bringing the resources of world science across their boundaries, and that 'in the scientific field where man is fighting the unknown, intellectual comradeship acquires extraordinary strength and value'.

The principle of the proposal found general favour among the delegates to the Council, some of whom spoke with enthusiasm of an 'international world institution'. Against the objection that there is a lack of trained personnel in the present decade, it was urged that such institutions could be the means of training extra personnel, especially in the smaller nations. The Indian delegation stressed the need to guard against the weakening of national initiative. The Russian and Ukrainian delegations commended the principle of the proposal and expressed their full approval of international scientific co-operation, but raised practical objections regarding expense and personnel. They believed that co-operation could be best achieved through a strengthening of national research laboratories and through the improvement of international exchange of research findings. The Council voted in favour of the proposal, by a large majority, and invited the Secretary-General of the United Nations to consult UNESCO and other specialized agencies concerned, and then to submit a Report on the problem of establishing United Nations Research Laboratories.

The resulting enquiry extended to agencies such as the World Health Organization, the Food and Agriculture Organization, the International Labour Organization and the International Civil Aviation Organization; then to the chief international and national scientific organizations; and to eminent practising scientists and administrators of science. Abstracts of some seventy replies have been published (United Nations, 1948) and analysed. The principle of the promotion of international research was generally favoured—enthusiastically so by some of the International Scientific Unions—but many of the replies dwelt upon reasons for caution, especially as regards material (and possibly temporary) aspects.

The Report of the Secretary-General was submitted to the Council in August 1948. In spite of its necessarily incomplete coverage, it made a great impression upon delegates, and was described by one of them as 'the most important document ever drafted by the United Nations'. The French delegation submitted a further resolution to the effect that, owing to the magnitude and diversity of the problem, the studies ought to be actively pursued. The resolution made specific proposals for further enquiry and discussion, with the establishment of a committee of experts in the basic sciences

(exact, natural and social), to examine 'the question of the possible establishment of international research laboratories, including the advisability of, and appropriate procedure for, convening an international conference of scientists'. During discussion, the representative of Australia, H. V. Evatt, pointed to the danger of establishing international projects which failed to live up to expectations, and expressed the belief that it would be best to embark on one or two laboratory projects with full hope of success. The resolution was adopted by fourteen votes to two, with two abstentions. The Russian and Ukrainian delegates reaffirmed their former views.

The UNESCO Report

Proposals for the establishment of international laboratories and observatories had been submitted and discussed at meetings in connexion with the Preparatory Commission for UNESCO in May 1946, and were examined at the First General Conference of UNESCO in November-December 1946. In February 1947 a substantial Report was presented by UNESCO in response to the invitation of the United Nations. This Report offered a series of Principles which should govern the determination of problems suitable for international treatment and their relative priorities. During the war, scientists had been impressed by the great power of *concerted attack* in the solution of specific problems, deliberately bringing together all of the material and personal resources required from many fields. Following this experience, it was realized that research into cancer, for example, requires the bringing together not only of advances in knowledge of proteins, enzymes, hormones, inductors, genes, carcinogens, viruses and other biological active substances, but also such provision and development of equipment (refrigerating centrifuges, freeze-dryers, ultra-violet spectrophotometers, electrophoresis apparatus, and so on) as is at present beyond the resources of any single nation. The *Principle of Ripeness*, which was well illustrated by the acceleration given to atomic research by the application of concerted attack under the stimulus of war at a suitable stage of atomic knowledge, would seem to indicate that the problem of cancer is now ripe for concerted attack, in conjunction with a project on the biology and chemistry of self-reproducing substances; and that a similar stage has been reached, for example, in the problem of tuberculosis. Other problems which are approaching 'ripeness' might include that of the statistical analysis of data on human biology (genetics, psycho-physical types, susceptibility to disease); and, later, the study of those aspects of individual and social psychology which produce social and international tensions.

The *Principle of Remoteness* recognizes that there are fields of science in which observations are lacking because they could be made only in places removed from existing centres of science. Thus in astronomy, observations are lacking from the southern hemisphere, which are urgently required in the study of astrophysics, cosmic rays, and solar-terrestrial relationships. In geophysics, as in oceanography and meteorology, observations must be made (for example, in geomagnetism, vulcanology and gravitation) in regions which have not reached a stage of development such that local scientists can undertake them on a national basis. Problems of food supply affecting the future security of mankind, and related problems such as in agronomy, soil science, forestry, drought studies, snow studies, erosion and fluid dynamics, should be tackled on a world basis which requires much of the research to be done in the scientifically 'dark' nations. In oceanography, and in a proportion of arctic research, the fields are geographically extranational.

The *Zonal Principle* recognizes that there are natural zones—the arctic regions, the tropical forest regions and the arid regions—in each of which the problems of ecology, resources, meteorology, human physiology, disease, nutrition, and so on, are largely homogeneous and are common to areas within various national boundaries. The *Principle of Transcendence of National Boundaries* recognizes that studies such as ornithology and entomology in general, or such as plague locusts in particular, must make and collate observations from many countries, both developed and undeveloped. Finally, the *Principle of International Pooling* refers not only to the flow of information and ideas, and to the establishment of standards and specifications, but to stockrooms such as of pure chemicals, of radio-isotopes, or of plastics;

and to collections such as of type-cultures of micro-organisms or of genetic mutants of the higher animals and plants.

Other Reports

It has been pointed out that, under the pressures existing today, those fields of science which cannot show prospect of definite or immediate national or commercial advantage are likely to be neglected in the provision of resources; and it is thought that they might have more chance of stimulation under the wider outlook of an international organization. Even if this were not so (for an international organization must itself secure funds and justify expenditure by expectation of return for outlay) it is suggested that, just as nations nowadays promote scientific research in their national interests, so the United Nations organization should promote its own research, in fields such as food, health, or social science, to further its own particular concerns.

Some of the scientific unions and practising scientists who were consulted responded with enthusiastic proposals for promotion of their own special fields. Some subjects, however, were put forward from several quarters. Suggestions included housing and sanitation; engineering materials; cartography, as a basic need for field sciences and for human communications and planning; rheumatism and malaria, as destroyers of efficiency; cardiovascular diseases, as the chief cause of death today; and the integration of the various sciences concerned in problems of the adaptation of man to his environment. A particularly strong case was made out for the establishment of an international institute for the study of the Brain. Such an institute, it was suggested, might be organized in separate services dealing with normal anatomy and pathological anatomy; embryology; genetics; normal and pathological physiology (cortical physiology and physiology of the peripheral nervous system); electro-neurology; biological chemistry; pharmacology and pharmacodynamics; bacteriology; epidemiology; neurology; neuro-surgery; psychiatry; psychology; sociology; statistics.

General Considerations

It is recognized that there are existing scientific institutions of international character. There are, for example, such services as the International Bureau of Weights and Measures; the International Meteorological Organization; the International Vulcanological Association; the International Seismological Summary; the International Time Bureau; the International Latitude Service. These are financed and controlled by groups of nations. Secondly, there are institutes of private or national origin designed to be international in character and service. These include the Isostatic Institute at Helsinki; the Oceanographic Museum at Monaco; the Roscoff Marine Biological Station; the International Zoological Station at Naples; the International High Altitude Station at Jungfraujoch; and the recently-created Institute for Scientific Research in the Belgian Congo. Thirdly, the great research centres existing in various countries have become, through their very greatness (in the scientific sense), international in character and effect. Among these may be mentioned the Biological Laboratory at Woods Hole; the Botanic Gardens at Buitenzorg; the Rockefeller Institute for Medical Research; and many others.

It may be mentioned that existing collections of type-cultures and of micro-organisms, though nationally owned and operated, perform an international function. These include collections in England (pathogenic bacteria and algae); U.S.A. (bacteria); Holland (fungi and yeasts); Brazil (bacteria); Switzerland (pathogenic bacteria); Czechoslovakia (algae and fungi); and China (industrial bacteria and fungi). Of significance also are the establishment of universities and colleges in Lebanon, China, etc., with their origins in countries such as the U.S.A.; and the provision of observatories and expeditions in various parts of the world by foundations such as the Rockefeller and the Carnegie.*

It is evident that there are various patterns which could be selected for the establishment of 'international laboratories', or for promoting at least some of the ends desired by those who have suggested them. Much could be done by the fostering of existing institutions—private, national and international. In this connexion, and in general, the spirit of international research may be furthered, and the benefits of concerted attack may to some extent be derived,

* Of six astronomical observatories in South Africa, one is supported by the nation, two by the United Kingdom, three by the U.S.A.

by considerably enlarging the provisions for travelling research fellowships, especially those for mature persons. If a 'World Institution' is to be set up in any field of science, questions arise as to whether it should be centred in one place, or scattered in sections among various nations; or, again, as to whether the field of such an institution should be defined in terms of one science, or in terms of a project in which various sciences are collated. The question also arises as to whether the United Nations organization itself, or UNESCO as the appropriate specialized agency, should be the body to adopt direct responsibility. In the immediate future of planning, it would appear that limitations to the finance proffered by nations to international scientific ventures would have the effect that large-scale research could be achieved only by so designing an international scientific institution as to produce a catalytic or trigger action upon research carried out independently.

UNESCO Determinations

The directives to the UNESCO secretariat for the year 1947, arising from the UNESCO Conference of 1946, included the exploration of possibilities for the foundation of new international scientific laboratories and observatories; among which might be institutes of:

1. astronomy;
2. nutritional science;
3. meteorology;
4. applied mathematics (computing machines);
5. tropical life and resources (Amazon basin);
6. health (specific diseases such as tuberculosis and cancer);
7. tropical disease field research station in northern Australia;
8. oceanography and fisheries of the Indian Ocean;
9. ornithology (bird migration).

Furthermore, the directives included the investigation of the feasibility of smaller projects, such as international stockrooms for:

1. pure substances not commercially obtainable;
2. new materials (plastics, glasses, alloys, etc.);
3. radioactive isotopes;
4. pure strains of laboratory animals.

In its Report of February 1947, UNESCO recommended to United Nations the following subjects as of first priority, in consideration of the most urgent human needs of the day:

1. an institute for the study of the chemistry and biology of the self-reproducing substances, including cancer research;
2. a chain of laboratories and field teams in nutritional science and food technology: e.g., in China; in the arid and arid-tropical zones; and in the humid equatorial area;
3. the study of the life and resources of the humid equatorial zone, beginning with an Institute of the Hylean Amazon and expanding into a chain of equatorial zone stations;
4. one or more institutes of oceanography and fishery in Asia, correlating their work with that of the nutritional laboratories.

Following these, in view of the urgent need for correlation of activities already begun by independent organizations, there was recommended:

5. an Antarctic research institute, including a meteorological institute for the southern hemisphere.

Then, in view of the small cost involved:

6. an ornithological observatory on Heligoland.

As second priorities:

7. an astronomical observatory in the southern hemisphere;*
8. an institute for research on tuberculosis;
9. computing laboratories, preferably in Asia;
10. an institute (or a series of laboratories) for human biological and genetical analysis;
11. a high-altitude station in the Himalayas;
12. an institute of human evolution in Africa;

* Harlow Shapley had proposed a principal observatory on the northern shores of the Mediterranean or on one of its islands, with a solar branch at higher altitude in northern Africa; and a powerful southern station in Peru, Chile or the Argentine. As regards the latter, his comment was: 'New Zealand and Australia possibly offer suitable sites, but for diplomatic reasons it may be best to keep international institutions outside the confines of the United States, France, the Soviet republics, and the British Empire'. See also below, page 134.

13. an Arctic research institute;
14. institutes and stations for the study of the arid zone;
15. an institute of individual and social psychology.

In addition, UNESCO had itself already undertaken concern for:

16. pool facilities for standards and type-collections;
17. improvement in documentation services.

In following years, UNESCO founded the Institute of the Hylean Amazon and called conferences to consider the establishment of institutes to deal with high-altitude research and arid zone research. In August 1949 the United Nations and UNESCO jointly convened in Paris a Committee of Scientific Experts upon International Research Laboratories. It was stated that the purpose was not to discuss the principle of creating such laboratories, which had already been fully accepted, but:

(*a*) to establish priorities according to the importance of the problems and the existing financial possibilities;

(*b*) to examine the desirability of convening a broader international conference on the subject;

(*c*) to find ways of securing support for the project not only from governments, scientific organizations and individual scientists, but from the general public.

The committee recommended the following projects as of highest priority:

1. International Computation Centre;
2. Institute for Psychophysiology of the Brain;
3. Institute for Social Studies.

Attention was also drawn to the importance of the following projects:

4. International Institute of the Arid Zone;
5. International Astronomical Laboratory;
6. International Biochemical Institute;
7. International Meteorological Institute.

Detailed proposals for the International Computation Centre were proposed before the end of 1949.

(*To be concluded*)

Scientific Approach to Art

Doris V. Coutts*

Schillinger's *Mathematical Basis of the Arts*† is a difficult book to read: it is an elaborate textbook for study, and if, as the author hopes, it is to find a wide range of readers, it is unlikely that they will be numerous. The approach to the subject is technical, scientific, philosophical. The terminology necessitates frequent reference to the Glossary compiled by the Editor, Arnold Shaw, whose notes elucidate many obscure passages. Large sections of the book are occupied by illustrative examples of algebraic series, formulae, graphs and diagrams. Some pages of designs add attractiveness to the book, which is, in all, a generous presentation of Schillinger's ideas to those who can receive them. His wife describes it as his masterwork, representing twenty-five years of research and discoveries. It reflects his enthusiasm, and an absolute faith that the work offers a scientific theory which *must* justify itself, if people will allow it 'to penetrate into all fields of knowledge, education and production for at least a generation'. He says that 'the dividends are too great to neglect'.

Joseph Schillinger was born at Kharkoff, and graduated from both the University and the Conservatory of Music in St. Petersburg, having specialized in Mathematics, Physics, Musical Composition and Conducting. He held several posts in succession, including that of Musical Consultant of the Soviet Union Board of Education (1926), then went to the United States of America, where he was naturalized. He lectured at the New School for Social Research. At the time of his death at the age of forty-seven he was lecturer in Mathematics, Music and the Fine Arts at the Teachers' College, University of Columbia.

Schillinger was a versatile, original and adventurous thinker. His achievements include his writings; his musical compositions, especi-

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† The Mathematical Basis of the Arts. By Joseph Schillinger. (New York: Philosophical Library, 1948. 696 pp., many text-figs. and tables. $6\frac{1}{2}'' \times 9\frac{1}{2}''$.) Price, $12.00.

ally *Symphonic Rhapsody*, commissioned by the Soviet Government to commemorate a decade of its rule, and *Airphonic Suite*, for the etherwave Theremin; also his inventions, such as the Rhythmicon, which automatically composes and performs rhythmical patterns, and an electro-magnetic organ with micro-tuning. He introduced and taught a new method of musical composition based on his 'system'; his pupils included George Gershwin, who renewed his inventiveness during four and a half years' study under Schillinger, two of which were devoted to composing the folk opera, *Porgy and Bess*, under his supervision.

In an age when, in the course of scientific study, many aspects of nature and human nature are reduced to measurement, when novels like H. Hesse's *Magister Ludi* are being written, the book calls for serious consideration. Its theory is too subtle for an outline of it to be both brief and lucid. Its aim is 'to disclose the mechanism of creatorship as it manifests itself in nature and in the arts'.

Part I of the book deals with Science and Aesthetics. Schillinger shows that there can be no line of demarcation between physical and aesthetic realities: both embody mathematical logic. His basic concepts are the laws of rhythm and the incidence and resultants of interference. Art forms, expressing themselves through physical media, and being perceived through organs of sensation, memory and association, are constituted of measurable quantities. Pattern conceptions reflect and project electro-chemical processes of the brain cells. Any phenomena can be interpreted and reconstructed if we detect *all* of the components involved and the exact form of their correlation; these can be expressed in a series of graphs, or numbers, through appropriate measuring lines (parameters). Through the instrumentality of science, or mechanics, an illusion of life, giving a reaction of emotion, is imparted to art. Greek sculptors worked out a system of proportions, worked within these limitations, and gained power to create art forms at high level. Gifted artists have always, in some degree, grasped intuitively the mathematical proportions involved in their object; but, as in the evolution of the aeroplane, conscious insight gives more power and freedom to select, than dreaming and impulse give.

In the scientific approach to art, each component of the object or idea is developed individually; all components are then assembled and co-ordinated into a harmonic whole. By further engineering, several arts can be integrated. The unscientific artist generates all components simultaneously: gaps and deficiency of logical and aesthetic coherence often result. The scientific method is valuable for the analysis, the modification, and the production of works of art. By its aid, remembering how photography became fused with colour, movement, speech, and sounds, great possibilities can lie ahead in the fusion of art forms through science.

Hitherto, aesthetic theories have failed to grasp the principles which control, and so explain, the emergence of creative ideas. Such a Theory of Regularity can be deduced from the creative inventions, scientific and artistic, of the past. The theory, here worked out, is based on the concept of Uniformity, at the root of which are three axiomatic forms of it: the system of count, in the field of reasoning; of space, in the field of vision; and of clock measurement, in the field of hearing. In each field, a series of fixed, evenly distributed points can be chosen from the manifold, and 'scales' formed. Space and time form a constant background for the discrimination of other relations, as do perception and consciousness psychologically. More complex forms of uniformity result from combining simpler forms. Harmonic relations and harmonic co-ordination provide the basis of the theory of all other configurations.

Part II of the book expounds the Theory of Regularity and Co-ordination thus founded; it gives the system of pattern-making and is the main part of the text. The techniques of the theory are explained and provide a clue to the process of creation. Those techniques are, Interference and the resultants produced, arrived at by computation and graphs; the Permutation series, through which secondary and tertiary series and 'family sets' are developed; Harmonic contrasts to the original sets are worked out, using distributive involution. Other techniques of variation and composition include arithmetical progressions, geometrical progressions, summation series and involution series, as configuration scales; also quadrant rotation, which provides four variants

of the original. A later chapter is devoted to quadrant rotation as a device for providing greater versatility while preserving unity in the writing of music. Mathematical procedures can enable a composer to plan a melodic composition in advance, and can facilitate the transcription of a harmonic continuity; for example, a four-part harmony offers twenty-four inversions (by permutation) in each of the four geometrical positions, and each voice can be transcribed horizontally. Co-ordinate expansion, positive and negative, may be used in arithmetical, geometrical and logarithmical expansion (or contraction). This gives variety and emphasis by distortion. Schillinger describes all of these procedures and the resulting types of designs in various arts. In music, geometrical expansion applied to the pitch co-ordinate changes the style of the music.

'One cannot fail in evolving a work of art according to the method of specification, selection and co-ordination.' The specifications must be chosen according to the meaning requirements. The artist is not restricted by scientific method, but released from vagueness: it helps him in his analysis, gives him a universal knowledge of his material and its possibilities, and permits numerous solutions. The technique is applicable to various arts: designs and melodies may be plotted as graphs, and the student may express them in any art-form desired; for example, in song, dance, drawing, etc. Works of art can be produced by computation, or by plotting a graph. They can therefore be realized mechanically in an art medium.

With a sufficient number of parameters, all the 'laws' pertaining to any functional system can be explained; where understanding is deficient, the necessary parameters have not been found. The parameters of any art continuum correspond to the functioning of the organ of discrimination. Schillinger describes the different art-forms which are possible and classifies them through the number of their general parameters.

Part III of the book deals with the technology of art production. This section, with its liberal illustrations, will appeal to the practical student who has absorbed the theory of the first two Parts.

Land Classification in Australia

J. K. Taylor*

Introduction

Land classification in the past in Australia has followed a relatively simple system and has been essentially the business of the Departments of Lands in the States. There has been little attempt at co-ordination of standards or of mapping between States and it cannot always be said that any rigid scheme has operated within any one State. Classifications of district units into first, second, and third class groups for valuation and for subdivision purposes have been based on the review on the ground of dominant vegetation, topography and more obvious surface-soil character. Strict correlations between districts have not always been observed and the gradings do not in consequence have comparative values. Classifications of land into vegetational groups—as forest and savannah or broad-use groups, as arable and non-arable, or topographic units, as mountain and plain, or any such inclusive terms—are not very informative if land classification is to be directed towards land utilization, and it is difficult to see any other reason for it. The drive for expansion and intensification of agricultural settlement in the past five years has brought this question forward, and has shown the gaps in knowledge of the nature of vast areas of country. Great advances may be expected in the next decade, particularly as soil surveys are spreading widely. The soil survey is the only sound basis for land classification.†

Soil surveys are broadly divided into three types: (*a*) reconnaissance—yielding a very broad soil group or even zonal group map; (*b*) broad scale—using soil association units and defining, without delineating, constituent soil types; (*c*) detailed—carrying the survey to the mapping of soil types and their main phases. From the soil association or soil type map, according to the quality of the country, it is an easy step to the land-use map, which involves collection of more intensive data on soil phases such as stoneyness, and on topographic relationships such as steepness. The most accurate land classification follows directly from the soil maps and land-use maps.

Naturally a land classification scheme depends on the objective. In some types of country one over-riding factor may dominate all other considerations. Over much of the drier regions of Australia, for example, rainfall is pre-eminent, combined with local flooding—particularly as only one industry, such as beef cattle, is concerned. Assuming diversity of potential land-use, however, the intensity of

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† For progress in soil surveys in Australia, see Report of A.N.R.C. Committee on Soil Classification. *Aust. J. of Sci.*, *12*, 92, December 1949.

settlement, which also governs land values, determines the scale of classification. In a recently conducted land-use classification of a new horticultural irrigation area (Loxton, South Australia), observations were made at the rate of about one boring per acre, whereas in a proposed fat-lamb development on comparatively poor soils (Kangaroo Island, South Australia) they were reduced to about one per thirty acres. The same principle applies to soil erosion. The question is what kind of land classification is desirable to meet the particular conditions of the territory being mapped, and the answer is not a hard and fast one, nor reducible to the old first-, second-, and third-class grouping.

Classification Schemes Used in Australia

Irrigation Soils

The Division of Soils, Commonwealth Scientific and Industrial Research Organization, has made attempts to classify the soils of irrigation areas in the Murray Valley into 'use' groups based on the collation of farming experience, experimental data on irrigability and drainage, and field observation of correlation between similar soils. It has been possible to draw up tentative but workable groupings of soil types for various horticultural, pasture and cereal crops.

The horticultural crops are broadly divided into citrus, stone fruits, pome fruits and vine fruits for drying or wine; vegetables may also be separated. A paper by Northcote (1949) deals with such groupings applied to the Coomealla Irrigation District, N.S.W. The system has been used in other areas on allied soil types quite successfully, so that the basis for land-use classification appears sound. Pasture as a grazing crop under irrigation has been divided into lucerne, perennial pasture with several dominants, and annual pasture with which may be associated such crops as sudan grass or sorghum. A further grouping concerns cereals and hay crops which are allied with less permeable and generally more intractable heavy clay soils with shallow surfaces. In all these groupings for irrigated crops, very much depends on water infiltration rates under various methods of application, on drainage, both internal and external, and on the nature of the surface horizon; for the horticultural grouping there is significance in the density and location of the calcareous horizon which is typical of the brown solonized soils frequently used for such crops in the Murray Valley.

At present six categories are used for the horticultural crops on brown solonized soils, and nine or ten categories for pastoral uses on the plains region in the Murray Valley.

Queensland

The Queensland Bureau of Investigation (1945-6-7-8) has carried out a considerable programme of land classification in units proposed for more intensive development. Piecing together of these will ultimately give a generalized view of the land-use position. The classification has taken various forms. When the soil pattern is very simple, one major group dominating the area, it may merely be divided into arable and non-arable. At other times, irrigability may matter, so that first class and second class irrigation land may be indicated on an arbitrary basis. For the rest, a kind of great soil-group classification is mainly used employing groups as red-brown earth, black earths, podzolic soils, grey and brown clays. Until these classifications are brought together for uniform interpretation, there will be a lack of understanding of the precise soil and land-use position. Correlations with known types as a yardstick are practicable for local workers, but these rather indefinite and variable groupings are a potential source of confusion to others.

North Australia

In 1946 a reconnaissance survey of soils and agricultural potential of North Australia was commenced under the direction of the Council for Scientific and Industrial Research, and is continuing at the present time. A gross area of about 120,000 square miles has been mapped as a broad land classification. The unit selected was the 'land system' (Christian and Stewart, 1947), which may be defined as an area in which there is a group of soils associated with a defined vegetational, geological and topographic pattern, in which may be recognized dominant and subdominant forms. The land system does not define the actual potential use of the country, but sorts out the areas with a general suitability in selected portions; for example, for irrigation development, for arable crops, for more intensive cattle raising, or for no recommended use. This broad land classification has proved very useful in narrowing the zone for further and more detailed examination and the location of experimental farm units.

Erosion Classification

One form of land classification likely to be increasingly used concerns soil erosion. The general approach by States whose duty it is to deal with this subject is to classify land into areas with certain conditions of erosion hazard. Maps of the position in Victoria, Tasmania, South Australia and Western Australia were prepared for the Rural Reconstruction Commission (Third Report, 1945). The hazard was defined in seven groupings as:

(a) greatest owing to liability to sheet and gully erosion;
(b) greatest owing to liability to wind action with hillside gullies;
(c) serious when land cultivated;
(d) occasional when land cultivated or overgrazed;
(e) localized in small places at present;
(f) generally slight;
(g) unoccupied areas.

Such broad categories can only be mapped broadly, but attention is thereby focused on the danger zones. Queensland has recently begun a mapping of erosion hazard in selected districts of the south-east of the State.

New South Wales (Kaleski, 1945) carried out an ambitious classification of 200,000 square miles in the eastern half of the State, using categories of use for cultivation or forestation combined with topography. Eight groups were used in mapping, namely:

(a) level to undulating, 0 to 8% slope—arable;
(b) level to undulating, 0 to 8% slope—grazing;
(c) undulating to hilly, over 8% slope—arable;
(d) undulating to hilly, over 8% slope—grazing;
(e) hilly to mountainous, over 20% slope—grazing.
(f) level to hilly, 0 to 20% slope—timbered land;
(g) hilly to mountainous, over 20% slope—timbered land;
(h) State forests.

The Council for Scientific and Industrial Research has dealt with the more precise classification of erosion over four selected units in Victoria and South Australia, aggregating 4000 square miles. The system devised has proved applicable over a wide range of conditions for broad scale or detailed work. It is based on that used by the United States Soil Conservation Service.

Other Work

Some areas have been classified on various bases by the Council for Scientific and Industrial Research, Division of Soils, and by the Melbourne University School of Agriculture. Correlation of soil with growth of *Pinus radiata*, and of soil series with sheep-carrying capacity or other land uses, has been done over limited areas in districts of Victoria and South Australia (Stephens *et al.*, 1941; Goudie, 1941). The Department of Agriculture in Western Australia has classified extensive areas in the south-west of the State, in the marginal wheat country, in terms of actual or potential salinity or freedom from it (Teakle, 1939). An area on the Ord River in the Kimberley region has also been examined for irrigability and land-use relations (Burvill, 1945).

Aerial Photography.

Land classification is immensely helped by the use of aerial photographs. There are limits to their interpretation, but with skeleton ground work it is often practicable to sketch, in a broad way, different classes of country whose character is established on the ground. The responsibility for photographic cover for Australia as a whole is assumed by the Royal Australian Air Force, photographing on a scale of 1/30,000 (two inches to one mile). This scale is satisfactory for broad-scale mapping. Aerial photography at larger scales is by private contract, and much of Victoria and Tasmania are now covered through State contracts at a scale of four inches to one mile, while similarly covered areas in New South Wales and South Australia are increasing. It is considered that in the next five years the great bulk of agricultural Australia, apart from very-low-rainfall inland areas, should be photographed at some scale. For practical purposes of land-utilization mapping, the four inches to one mile scale is required, and in intensive horticultural units the six or eight inches to one mile scale.

Climatic Analysis

As an aid to land classification work there should be mentioned the increasing volume of climatic analysis, by improved methods, which has been carried out over the past fifteen years and is steadily advancing. The Commonwealth Meteorological Office is now assuming an active interest in this field from the agricultural angle, extending the earlier work of the universities, which pioneered the work. Recent homoclime studies are a further aid in interpretation of field observations on land use.

Conclusion

The soil survey of Australia, at some level, must go ahead of, or parallel, the main attack on land classification and utilization in order to produce a sound map which is usable also for exploratory and experimental work and for the application of results. In selected regions, detailed soil maps have to precede detailed land-use maps. Other countries have developed a system of classification with very detailed maps; Australia has not devoted sufficient attention to sound classification methods, and particularly to the co-ordination of work by various agencies. Resources surveys are still restricted, as has been shown in recent discussions of future irrigation developments. Soil resource mapping should be a major objective in the next ten years, in order to obtain the overall pattern for research and primary development in Australia.

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Cybernetics

T. G. ROOM*

IN his book, *Cybernetics*,† Dr. Wiener sets out to give an integrated account of what appear to be two widely different general topics, namely, Time-series and Communication Engineering, and the applications of these in all branches of science. A time-series consists of a set of measurements of the same characteristic of some phenomenon, taken either continuously or at intervals of time. Thus the temperature at a given place, the density of traffic along a given stretch of road, and the population of a given area all provide time-series. The purpose of the analysis of time-series is to enable predictions for the future to be made on the basis of data from the past; that is in effect, to try to disentangle trends from fluctuations, both random and periodic.

The central problem of communication engineering is that of transmitting a message. The message begins as words; it is first transformed into sound or electric waves either directly or through morse or other code, then transmitted in this form, and finally reconverted into words. In the transmission phase we have a time series; in its simplest form a succession of short and long impulses, and in its more general form a discrete or continuous sequence of 'events'. The problem is to arrange for the optimum transmission, where in determining the optimum we have to take account both of the degree of accuracy of the reception (which needs to be only high enough for the message to be intelligible) and the time-lag between the formulation of the original message and its reconversion into words. From this basic idea the scope of the term 'communication engineering' is extended to cover any process involving the interpretation of a sequence of impulses; i.e., the problem in all cases is the elimination of 'noise' ('noise' being oscillation in inconvenient places, just as 'dirt' is matter in inconvenient places) in order to recover the 'information', and this with a minimum time-lag.

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† CYBERNETICS. By Norbert Wiener. (New York: John Wiley, with The Technology Press, 1948. 194 pp., 8 text-figs. 6″ × 9″.) Price, $3.00.

A fundamental process of this class is the 'feed-back'. The key example of this is the operation of a ship's rudder. In this operation there are three factors involved: the intended course of the ship, the actual course of the ship, and the setting of the rudder. The actual course of the ship determines the setting of the rudder, which will tend to restore the ship to its intended course. That is, the *information* as to the actual course is *fed back* to some mechanism which converts this information into an impulse causing the rudder to shift into a position tending to bring the ship back on to the required course. The actual course of the ship constitutes a time-series, and the immediate past history of the ship determines the setting of the rudder. The communication problem is that of transmitting this history to the rudder mechanism. The word *Cybernetics* itself is taken from the Greek word for 'Steersman', a word which, as 'Governor', has already taken its place in the language in much the same sense.

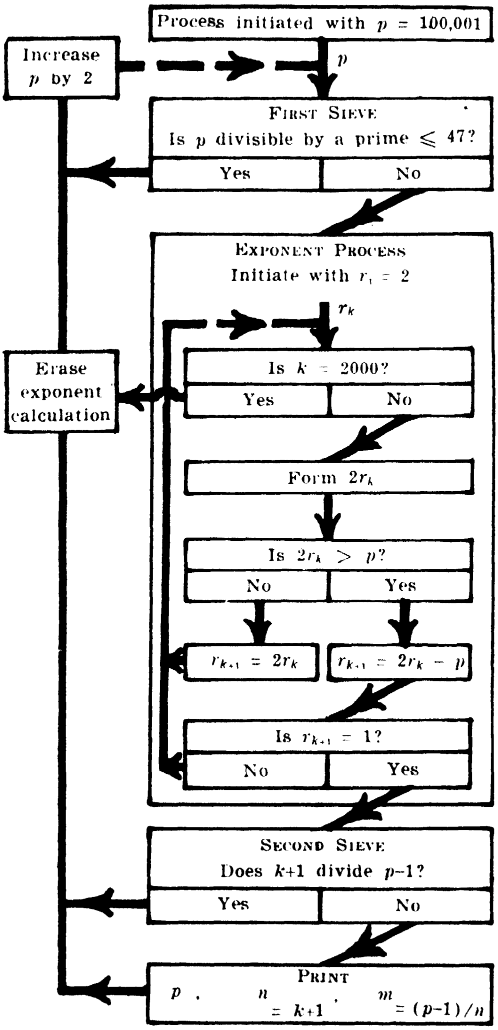
High-speed computing machines play two distinct and important roles in Wiener's work. Their first role depends on their mode of operation, which is used as a model for physical, physiological, psychological, and sociological processes; their second depends on their function, namely, to carry out arithmetical operations with such speed and accuracy that problems, the solution of which has hitherto been physically impossible, can now be dealt with in a matter of hours. So important to an understanding of this book is an appreciation of what these machines can do and how they do it, that it seems advisable here to interpolate the description of a small-scale attack that was made, using the ENIAC, upon the problem of determining which numbers, in a certain range of large numbers, are primes. This is quoted, with some modifications for the sake of simpler description, from a paper by D. H. Lehmer (1949).* Perhaps the most important aspect of this work is not that the list of prime numbers was considerably extended, but that, as a spare time activity over one week-end, calculations were made which on any machines available ten years ago would have required a prohibitive number of man-hours.

The machine was not set to the direct discovery of primes, but to the solution of an auxiliary problem, namely, to find, for each prime p in a given range, the least integer n such that $2^n - 1$ is a multiple of p.† The range

* For a description of the ENIAC machine itself, see, for example, Hartree (1947).

† If p is prime, then $2^{p-1} - 1$ is a multiple of p, but there may be numbers $h < p-1$, such that $2^h - 1$ is a multiple of p. The number sought, n, is the least of these numbers h, and it is easy to see that it must be a factor of $p - 1$. For example, if $p = 43$, we know that $2^{42} - 1$ is a multiple of 43; and if there is any number, h, < 42, having the required property, then h is a factor of 42. Thus we have only to test 2, 3, 6, 7, 14, 21; we find $n = 14$.

chosen was 10^6 to $4{\cdot}5 \times 10^6$, and knowledge of the value of n corresponding to each prime p in this range suffices to determine primes in a range of much higher values than this.* Further, values of $n > 2000$ were not needed. The whole process on the machine is set out in the following diagram, in which the 'feed-backs' are indicated on the left.



It is important to notice that the machine is set to run for an indefinite period after the 'programme' is established and the first value of p (100,001) is fed in. To enable it to do this: (i) The machine is not set so that at the outset it rejects all values of p that are not prime, but through the 'first sieve' it rejects a large proportion of the numbers.

* Namely, at least up to 10^9.

(ii) In the 'exponent process' for each p the machine tests all values of k to find if $2^k - 1$ is a multiple of p.* If the computation were done by hand only those values of k would be tested which are factors of p–1. But the machine takes less than 2½ seconds to perform the whole set of tests for one value of p, which is less time than it takes to copy down by hand the value of p. (iii) If $2^n - 1$ is a multiple of p, and n is not a factor of p–1, then p is not a prime, so that the 'second sieve' rejects further non-prime values of p.‡ (iv) The machine prints values of p which pass the two sieves, together with the smallest number n, and the corresponding integer m, such that $2^n - 1 = mp$.

Once started, the machine will continue to compute a list which will contain mostly primes p, with the corresponding n and m, but in which there will be included a few non-primes. A separate operation (one which can be performed in reasonable time by hand) is necessary to eliminate these. As an indication of the speed of operation, it may be noticed that over two million numbers were fed into the first sieve, and about three-quarters of these are removed by the sieve. That is, in the week-end, half a million numbers passed through the 'exponent process'.

We return now to the discussion of Wiener's book. It may be divided into two clearly defined sections. The Introduction, Chapter I, and Chapters V through VIII, are concerned principally with the analogy between the mechanism of the computing machine and possible mechanisms for natural processes. These chapters are descriptive and involve very little mathematics. On the other hand, Chapters II, III and IV are heavily mathematical in the modern style; which does not, at the outset at any rate, aim at definite results, either in numerical form or in terms of particular functions, but rather at broad mathematical statements involving unspecified functional forms. The modern viewpoint may be said to be that mathematics is concerned with concepts, not symbols, although symbols are necessary to express the concepts. In the background of Wiener's work is also the idea that at some future date specific functions can be fed into the machines and something tangible will result. The three chapters are to a considerable extent outlines of possible mathematical treatments of the general problem of communication; namely, how much information can be derived from a 'garbled' message: how much knowledge of the future can be gained from a partial and inaccurate knowledge of the past.

* For p = 43, the steps in the exponent process are: $r_1 = 2$, $r_2 = 4$, $r_3 = 8$, $r_4 = 16$, $r_5 = 32$, $r_6 = 21$, $r_7 = 42$, $r_8 = 41$, $r_9 = 39$, $r_{10} = 35$, $r_{11} = 27$, $r_{12} = 11$, $r_{13} = 22$, $r_{14} = 1$.

‡ Suppose, for example, that 15 had been a number which passed through the first sieve. For $p = 15$, $r_1 = 2$, $r_2 = 4$, $r_3 = 8$, $r_4 = 1$; but 4 is not a factor of $p-1 = 14$, so that the number 15 does not pass the second sieve. Only about one composite number in 500 passes through this sieve.

In substance Chapter II discusses this problem: a given system, which is changing with time, is capable of a continuous or discrete family of 'states' or 'phases', each of which may be assumed with a certain probability. What are the mathematical conditions under which the probability functions are such that the phase-average, taken over all possible states, is equal to the time-average of the states actually assumed?

Chapter III is probably the most important contribution to mathematics in the book, since it sets out a mathematical definition for the 'amount of information', and discusses the consequences of this. The definition is such that the 'amount of information' is infinite if the information is correct with probability 1, and zero if it is correct with probability zero, while if the information is incomplete and partially inaccurate it is to be regarded as correct with probability p. Suppose a quantity has, *a priori*, equal probability of lying anywhere in the range (0,1). It may be expressed as

$$a = a_1(\tfrac{1}{2}) + a_2(\tfrac{1}{2})^2 + \ldots + a_m(\tfrac{1}{2})^m + \ldots,$$

where each a_i is 0 or 1. If the quantity is known precisely, then the 'amount of information' is infinite, because we know every figure in the infinite sequence $a_1, a_2, \ldots$. In practice a quantity is never known precisely, but only as lying within a range

$$b = b_1(\tfrac{1}{2}) + b_2(\tfrac{1}{2})^2 + \ldots + b_n(\tfrac{1}{2})^n + \ldots$$

Now suppose we have a measurement, a, of a quantity known to lie between 0 and $(\tfrac{1}{2})^h$; that the true value of the quantity lies within a range of b of any measurement; that $b_1, \ldots, b_k$ are zero, and $b_{k+1} = 1$; and that $k > h$. Then the significant figures, $a_h, \ldots, a_{k-1}$, and perhaps a_k, in the measurement, a, are known certainly; but the others have no meaning. Thus the number of significant decisions made, in making the measurement, namely $k - h$, or $k - h - 1$, is about $\log_2(a/b)$. If we know, *a priori*, only that the quantity lies between 0 and 1 and that the true value lies within a range b of the measurement, then the number of significant decisions is $-\log_2 b$.

This idea is now generalized in the following way. Suppose the probability of any value of a variable x is given by a function $f(x)$, so that $\int_{-\infty}^{\infty} f(x)\, dx = 1$. Then, the 'amount of information' given by this probability function is to be defined as $\int_{-\infty}^{\infty} [\log_2 f(x)] f(x) dx$. In the simple case above the probability function is $f(x) = 1/b$, over a range b, and $f(x) = 0$ elsewhere, and the integral gives the required value $-\log_2 b$. The rest of Chapter III is devoted to mathematical elaboration of this idea, using multi-variate Fourier Analysis. In a book published more recently (but written earlier), Wiener (1949) carries out this investigation more thoroughly and rigorously on a slightly different functional form.

Chapter IV deals with the problem of 'feedback and oscillation'. In essence the problem is this: a system is required to be in a certain state (as a ship on a course); if it is not in this state, the deviation is a piece of information communicated in some manner to a control mechanism, which sets up some operation which will move the system towards the desired state.* The final result of this operation is some other state which may still deviate from that required. In a proper system, the control is such that the deviations decrease, producing stability. The chapter is mainly concerned with a discussion of the mathematical theory of stable and instable control mechanisms and with physiological analogies of these.

Before discussing the remaining chapters we need to look again at the structure of the ideal computing machine and the programming of work for it. These should be such that all data can be inserted at the beginning of the run; that there should be no human interference with the machine during the run; and that the required results should appear either seriatim or at the end of the run. These qualities are all present in the example quoted above. The thesis of these last chapters is that many natural processes are imitable on the machine. Explicitly, these processes may be described as a sequence of events of the following pattern. An impulse of a certain kind (a 'piece of information') is received by an operator Q from an operator P. As a result of it Q initiates impulses of two types, one which enables the programme to be continued (that is, which passes on a piece of information to the next operator, R), and the other which feeds back, to an earlier operator, information as to the state of Q after receipt of the impulse from P, and so governs the future behaviour of Q.

Chapter V compares computing machines and the nervous system, and sets out two striking common features, namely, the feedback, and the 1-or-0 operation of the machine, and its parallel, the complete-or-no response of nerves to stimulus. The two following paragraphs (pp. 153 and 155) illustrate well the style of the book and the trend of the argument.

> There is nothing in the nature of a computing machine which forbids it to show conditioned reflexes. Let us remember that a computing machine in action is more than the concatenation of relays and storage mechanisms which the designer has built into it. It also contains the content of its storage mechanisms; and this content is never completely cleared in the course of a single run. . . . We have seen that in the nervous computing machine it is highly

* For example, in the 'exponent process' a number is continually doubled until the result exceeds p, then p is subtracted from the result, and the doubling process resumed. In this case the machine achieves the final result perfectly, since at some stage the result of a doubling is $p + 1$.

probable that information is largely stored as changes of permeability in the synapses; and it is perfectly possible to construct artificial machines where information is stored in that way.

As a final remark, let me point out that a large computing machine, whether in the form of mechanical or electric apparatus or in the form of the brain itself, uses up a considerable amount of power, all of which is wasted and dissipated in heat. The blood leaving the brain is a fraction of a degree warmer than that entering it. No other computing machine approaches the economy of energy of the brain. . . . The mechanical brain does not secrete thought 'as the liver does bile' as the earlier materialists claimed, nor does it put it out in the form of energy, as the muscle puts out its activity. Information is information, not matter or energy. No materialism that does not admit this can survive at the present day.

Chapter VI is somewhat isolated from the rest, and discusses first the recognition through the human eye of 'shape' independently of size and orientation; and then, possible electrical devices which could do this, with special reference to a machine that could identify (for the purposes of transmission) printed letters in types of different sizes.

Chapter VII is headed 'Cybernetics and Psychopathology'. It comes back to the control by animals of the performance of muscular actions by an elaborate feed-back, in which the brain dictates only what the result of the action is to be, and the nervous controlling mechanisms then set in motion the succession of muscular movements necessary to carry the action to a successful conclusion.

Finally, 'Information, Language and Society'. Von Neumann's theory of economics (1944) sets out the economic structure of society as controlled by players, completely intelligent and completely ruthless in furthering their own interests—a condition which, Wiener proves under his hypotheses, leads to complete chaos. But, says Wiener, this is not a completely true description of capitalist society, as all men are partly foolish, and none completely knavish.

On the whole this chapter is the least worthy, as it shows no depth of appreciation of sociological problems, and the controlling mechanism which governs the author's course across sociological waters seems to be insensitive to deviations to port. The following two quotations provide admirable (verbal) examples of feed-back, but cannot be ranked highly as contributions to political science. 'A certain mixture of religion, pornography and pseudo-science will sell an illustrated newspaper.' 'A certain blend of wheedling, bribing, and intimidation will induce a young scientist to work on guided missiles and the atom bomb.'

The book is certainly one to be read by all with an interest in new fields of scientific exploration, and it is recommended with this reservation: the mathematics is difficult, often inadequately explained, and abounds in misprints, being more inaccurately printed than any mathematical text the writer of this review has read; but it offers suggestions of what may become a new and valuable mathematical approach to engineering, physiological, and sociological problems. If you ignore the mathematics you will find, as the American public has found, an interesting, provocative, and stimulating book.

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The International Astronomical Union

THE International Astronomical Union (I.A.U.) was founded at the Constitutive Assembly of the International Research Council held at Brussels in July 1919. About a year elapsed before formalities were completed to such an extent that the Union could be definitely established. It was not the first international body to deal with astronomical matters, having been preceded, for example, by the International Union for Co-operation in Solar Research as well as by the International Latitude Service and others. It has now become well recognized by astronomers in most countries participating in astronomical research. The purpose of the I.A.U. is twofold, viz.

(a) to facilitate relations between astronomers of different countries where international co-operation is necessary or useful;

(b) to promote the study of astronomy in all its departments.

At present thirty countries (including Australia) are recognized as adhering to the Union. A country adheres through the appropriate National Academy, National Research Council or similar national institution. In default of these, adherence may be effected through a government or a national committee of astronomy recognized by the Executive of the I.A.U.

The work of the Union is directed by a General Assembly of the members, meeting as a rule every three years. The General Assembly elects an Executive Committee consisting of a President, not more than five Vice-Presidents, and a General Secretary. The President holds office for one meeting of the General Assembly, and is not eligible for immediate re-election.

The remainder of the Executive Committee holds office for two meetings of the General Assembly. The last General Assembly, which was held at Zurich in 1948, was presided over by the Astronomer Royal, Sir Harold Spencer Jones.

The General Assembly also appoints Standing Committees (Commissions) for the more detailed scientific work of the Union. The Commissions present reports of their work to the Union. At present, more than forty Commissions exist. Amongst the subjects of more general interest dealt with by these Commissions are the calculations required for the *Nautical Almanacs* of various countries; these calculations are shared internationally. Another Commission deals with Astronomical Telegrams—that is, the notification of astronomical discoveries such as comets, new planets, etc. —so that the resources of the world observatories can be quickly brought to bear on the study of any new object. A *Quarterly Bulletin of Solar Activity* is issued by another Commission; the section of this publication dealing with Solar Noise is edited by Dr. Allen of the Commonwealth Observatory. A special Commission has been created to study the problem of establishing international observatories; whilst no concrete results have as yet arisen, it is of interest to note that the Commission is agreed that any new international observatory should be located in the Southern Hemisphere in latitudes lying between 10° and 40°; that any proposed site should be carefully tested; that the basic equipment should consist of a large reflector (between 75 and 125 inches) and a large-field Schmidt-type reflector of aperture between 30 and 60 inches.

National Committees on Astronomy play an essential part in the structure of the I.A.U. The National Committees are either formed or recognized by the body through which the country adheres to the Union. The functions of the National Committees are (a) to promote and co-ordinate in their respective countries the study of the various branches of astronomy, more especially in relation to international requirements; (b) to nominate delegates to the General Assembly; and (c) to propose motions for discussion by the General Assembly.

Australia adheres to the I.A.U. through the Australian National Research Council. The names of members of the Australian National Committees were given in the previous issue of This Journal (*12*, 101, 1949).

The South Pacific Commission

History and Constitution

The South Pacific Commission (headquarters Noumea, New Caledonia) is a consultative and advisory body set up by the six governments administering territories in the South Pacific region. Its purpose is to recommend to the member governments means for promoting the well-being of the peoples of these territories. It was established by the Agreement signed at Canberra on 6 February 1947 on behalf of the governments of Australia, France, the Netherlands, New Zealand, the United Kingdom and the United States of America. The area of activities comprises the non-self-governing territories lying generally south of the Equator, from and including Netherlands New Guinea in the west to the French establishments in Oceania in the east.

The *Commission* consists of twelve commissioners, two from each government, and meets twice a year. Four sessions have been held, the first two in 1948 at Mosman, N.S.W., and the third and fourth at Noumea in May and October 1949. The staff includes six principal officers and a *Secretariat*, the six principal officers being the Secretary-General, the Deputy Chairman of the Research Council, the Deputy Secretary-General and three specialist members of the Research Council, one each for the three main fields of activity—Health, Economic Development including Agriculture, and Social Development including Education.

The main auxiliary body is the *Research Council*, which held its opening meeting at Noumea in May 1949 and will hold its second meeting at Sydney in August 1950. The Research Council consists of the Deputy Chairman, the three specialist members and fifteen associate members chosen for their special knowledge of the problems of the territories. The chief task of the Research Council is to recommend investigations and, with the assistance of the Secretary-General, to make arrangements for carrying out those approved by the Commission.

In addition to the Commission, the Secretariat and the Research Council, a South Pacific *Conference*, consisting of representatives and advisers from the territories, including indigenous inhabitants, will meet every three years to discuss the work of the Commission. The first Conference will be held at Suva in April 1950.

Summary of Work Programme

At its third session in May 1949 the Commission approved 29 projects recommended by the Research Council. These projects are briefly summarized as follows:

Health Projects:

- H.1.—Improvement of the collection and dissemination of epidemiological intelligence.
- H.2.—The preparation of suitable infant food during the weaning period.
- H.3.—A special team to compare (i) the different antigens and methods used in tuberculin tests; (ii) the radiographic appearances in different races at different ages, with a view to producing simple techniques suitable for use under field conditions.
- H.4.—Liaison between field groups working on filariasis and elephantiasis.

H.5.—Collection of existing data on diet and nutrition.

Economic Development Projects:

E.1.—The introduction of economic plants.

E.2.—Review of the information on cash crops, their place in Area economy, and the future of cacao, rice, the coconut and copra.

E.3.—Improvement in tropical pasture grasses.

E.4.—A pilot land-use survey (hydrological and forestry reserves, erosion control, identity of crop and pasture lands, soil classifications).

E.5.—To secure Area standards in the grading and quality of plant products.

E.6.—A study of atoll and low-island economy, designed to improve cash and subsistence crops and handicrafts.

E.7.—A study of fishery methods in relation to needs of the Area.

E.8.—An examination of diet of indigenous peoples with the objective of amplifying it; and the study of the kinds of agricultural working tools needed.

E.9.—Expansion of biological control (the mosquito, insect pests and weeds; plant hygiene and rodent control).

E.10.—Means of making available commercial credit for the development of enterprises by indigenous peoples.

E.11.—Co-operation in connexion with the proposed agricultural census in 1950 (F.A.O.).

E.12.—Support for certain projects of the Fiji and Western Pacific Research Council.

E.13.—Collection of information on current and proposed investigations in animal husbandry and land-use.

Social Development Projects:

S.1.—A survey of the facilities for profesional and technical training in the South Pacific, with a view to future development.

S.2.—The use of visual aids in education among island peoples.

S.3.—A study of the most suitable techniques for teaching literacy in the Area.

S.4.—Conference of educationists.

S.5.—A review of research in social anthropology, with emphasis on needs.

S.6.—A survey of work done and still required in the field of linguistic research.

S.7.—The co-operative movement in the South Pacific and its development.

S.8.—The determination of the most suitable building types for the various climatic zones and conditions in the Area.

S.9.—Pilot projects for community development in two selected areas.

S.10.—The preservation of archaeological sites.

General:

G.2.—Statistical service. Appointment of a qualified statistical officer.

PROGRESS TO DECEMBER 1949

Arrangements for the epidemiological project have been completed. The tuberculosis team is being assembled and is expected to begin work in New Guinea early in 1950. A nutritionist is being sought to deal with projects H.2. and H.5. Assistance has been given by the Commission in the development of introduction gardens in Fiji and New Caledonia. The Member for Economic Development has visited North America and Europe to make a first-hand survey of marketing factors for South Pacific cocoa and coconut products. A study of soil formation on coral islands is in progress. A specialist has been engaged for six months to survey the needs of the area for technical training. An expert on visual education is now at work in New Guinea (S.2.).

A review of research work on Melanesian anthropology is being conducted by Professor A. P. Elkin, and project S.6. (linguistic research) is in the hands of Dr. Capell of Sydney University. A pilot community development project has been organized, to be carried out at Motoriki, Fiji. The proposed conference of educationists has been deferred. The collection of information on all projects is proceeding and provision has been made for the compilation of working bibliographies.

Scientific Abstracting

THE need for an intensive review of the system of publication of scientific papers was voiced at the Empire Scientific Conference, 1946; in response to that need a Scientific Information Conference was called by the Royal Society in June 1948. The Conference was arranged in four Sections, with the respective objects of appreciating and discussing what can be done to improve and rationalize the arrangements for:

(1) Publishing and distributing original scientific papers.

(2) Issuing and using abstracts to convey current awareness of availability and relevance of such papers.

(3) Consolidating abstracts or other forms of reference into continuously cumulative indexes and using these and other library services for the retrospective searching of the literature.

(4) Producing and utilizing periodical reviews of progress in designated fields of science.

Preliminary notes were prepared for the four Sections by Professor J. D. Bernal, Sir David Chadwick, J. E. Holstrom, and Professor H. Munro Fox respectively.

At the concluding session, on 2 July 1948, the Conference adopted resolutions which it invited

the Council of the Royal Society to consider. Only the recommendations regarding abstracting services (i.e., for Section 2) will be included in this account. It was recommended that a Standing Committee on Abstracting be constituted, composed of representatives from bodies publishing abstracts, to be voluntary and consultative, with the object of promoting co-operation. Discussion should take place upon uniformity of bibliographical citation; the publication of annotated lists of abstracting journals; maintenance of a panel of abstractors with linguistic knowledge; annotation of lists of periodicals to indicate relevant abstracting services; the adequacy of existing cover.

The Conference decided that knowledge of papers published, or about to be published, should be made promptly available, and it recommended that societies and other bodies should issue lists of accepted, forthcoming papers, annotated if possible. Books, theses and governmental reports might be similarly served. Lists should also be issued on a regional basis throughout the British Commonwealth; this might provide the preliminary organization for regional abstracting, as recommended by the Empire Scientific Conference in 1946.

The Conference studied the presentation of abstracts, and recommended that:

- more detailed abstracts should be prepared when the original article appears in a foreign language or in a publication not readily available;
- the original language should be indicated when not obvious;
- titles of articles should be translated, but the names of the publications containing them should be in the original languages, transliterated if necessary;
- abbreviations of title should follow the *World List of Scientific Periodicals*, or a key should be provided;
- location of the author should be given when practicable;
- a comprehensive subject-index should be compiled for every volume of abstracts, with particular attention to the choice of headings, and to the system of cross-referencing;
- a consolidated subject-index should be issued at least once in each ten years;
- abstracting organizations should explore all possibilities of securing advance copies of papers, reprints, page proofs, etc., so as to ensure the earliest possible appearance of an abstract, and editors of journals should co-operate in this.

Authors' Summaries

The following recommendation was adopted concerning authors' summaries:

> The present general unsuitability of authors' summaries for use as abstracts is recognized; nevertheless, if these could be used it would increase the speed of publication and reduce the cost of journals publishing abstracts. Editors of scientific journals should therefore be invited to co-operate with abstracting organizations by seeing that each paper is accompanied by a factual summary suitable for use as an abstract in appropriate journals of abstracts; and that, at the same time, abstracting organizations be called on to formulate agreed principles to guide editors of scientific journals.

Consideration to this recommendation was given by the Abstracting Services Consultative Committee and by the Royal Society Information Services Committee. The latter submitted the following proposals, which were endorsed by the Council of the Royal Society on 7 April, 1949:

(1) It is desirable that every paper appearing in a scientific journal be accompanied by a synopsis which should be independent of the text and figures and should preferably appear at the beginning of the paper.

(2) The synopsis should be subject to the same editorial scrutiny and correction as is usual for the full paper. Automatic acceptance of a synopsis written by an author is not desirable.

The Council asked that abstracting services should indicate clearly, in an abstract, when they are using the author's synopsis. To accompany its invitation to publications to adopt these recommendations, the Royal Society has supplied a *Guide for the Preparation of Synopses*, prepared by the Abstracting Services Consultative Committee. This is given below. In Australia, whose delegates to the 1948 Conference especially stressed the importance of synopses, the C.S.I.R.O. Information Service has been asked to act as the co-ordinating body for implementing the recommendations, and would appreciate comment as to agreement with the principles. The Information Service is itself responsible for abstracting a great part of scientific literature published in Australia, both for inclusion in locally published abstracts and for transmission to world abstracting services.

Guide for the Preparation of Synopses

1. *Purpose*

It is desirable that each paper be accompanied by a synopsis, preferably appearing at the beginning. This synopsis is not part of the paper; it is intended to convey briefly the content of the paper, to draw attention to all new information and to the main conclusions. It should be factual.

2. *Style of Writing*

The synopsis should be written concisely and in normal rather than abbreviated English. It is preferable to use the third person. Where possible, use standard rather than proprietary terms, and avoid unnecessary contracting.

It should be presumed that the reader has some knowledge of the subject but has not read the paper. The synopsis should therefore be intelligible in itself without reference to the paper; for example, it should not cite sections or illustrations by their numerical references in the text.

3. *Content*

The title of the paper is usually read as part of the synopsis. The opening sentence should be framed accordingly and repetition of the title avoided. If the title is insufficiently comprehensive the opening should indicate the subjects covered. Usually the beginning of a synopsis should state the objective of the investigation.

It is sometimes valuable to indicate the treatment of the subject by such words as brief, exhaustive, theoretical, etc.

The synopsis should indicate newly observed facts, conclusions of an experiment or argument, and, if possible, the essential parts of any new theory, treatment, apparatus, technique, etc.

It should contain the names of any new compound, mineral, species, etc., and any new numerical data, such as physical constants; if this is not possible it should draw attention to them. It is important to refer to new items and observations, even though some are incidental to the main purpose of the paper; such information may otherwise be hidden, though it is often very useful.

When giving experimental results, the synopsis should indicate the methods used; for new methods the basic principle, range of operation, and degree of accuracy should be given.

4. *Detail of Layout*

It is impossible to recommend a standard length for a synopsis. It should, however, be concise and should not normally exceed 200 words.

If it is necessary to refer to earlier work in the summary, the reference should always be given in the same manner as in the text; otherwise references should be left out.

When a synopsis is completed, the author is urged to revise it carefully, removing redundant words, clarifying obscurities, and rectifying errors in copying from the paper. Particular attention should be paid by him to scientific and proper names, numerical data, and chemical and mathematical formulae.

Lists of Abstracting Services

The Abstracting Services Committee of the Royal Society supervised the compilation of a comprehensive *List of Abstracting Journals*. There are 127 entries in respect of Great Britain, and an appendix covers other countries of the Commonwealth. Each entry indicates the subjects covered, number of abstracts per year, published price, name and address of the issuing authority, and details as to frequency of issue of parts and of indexes. The document was issued in June 1949 and is available at 2*s*. 6*d*. per copy.

For the International Conference on Abstracting convened by UNESCO in June 1949, a *List of Current Specialized Abstracting and Indexing Services* was prepared by the International Federation for Documentation (F.I.D., Publication No. 235, 6 Willem Witsenplein, The Hague, Holland). This contains about 1500 entries over the whole range of the pure and applied sciences, with related humanities. It includes not only abstracting journals and indexes of titles, but many other journals which give, or might give, similar information occasionally. It is, in fact, a printing from a card index which resulted from the making of a preliminary post-war survey undertaken by F.I.D. at the request of UNESCO. The survey found difficulty in securing information from the smaller services, while 'the information about Russian abstracting services is perfectly inadequate'. It is stated in the introduction that:

> the present status of the abstracting work in the whole world is still very confusing. Many services do not receive regularly foreign periodicals and some of them got into financial difficulties. During the period of conducting the survey, three important services collapsed; practically no large service is self-supporting. New services have started on a more or less uncertain basis.

The F.I.D. publishes the list in the hope of drawing suggestions both for additional titles and for the suppression of less important titles. It believes that the criterion for including titles should be that an abstracting or indexing periodical is *fit to make retrospective literature searches*.

UNESCO Conference on Abstracting

An International Conference on Science Abstracting was called in Paris by UNESCO from 20 to 25 June 1949, according to instruction given by the Beirut Conference for the 1949 Programme.* The Conference was attended by about 85 delegates and a greater number of observers, representing 28 countries and 24 international organizations. Professor Pierre Auger (France) and Dr. Alexander King (United Kingdom) acted as chairmen. Australia was represented by J. E. Cummins (Chief Scientific Liaison Officer, London) and Miss E. S. Hall (Director of Training, National Library, Canberra). In addition, Miss J. Halkyard attended as an observer on behalf of the Association of Special Libraries and Information Services, Melbourne.

Documents were circulated before the Conference as a basis for discussion, the most important being a report prepared on behalf of UNESCO by Dr. Therese Grivet. This made extensive references to the Royal Society Scientific Information Conference in 1948, thereby

* This Journal, *10*, 46, 1948; *11*, 18, 1949.

providing a background without which the UNESCO International Conference could have achieved much less. It was evident that discussion and clarification of English-speaking views following the 1948 Conference, especially through the various units of the British Commonwealth Scientific Offices (London), contributed materially to the general agreement reached at the Paris Conference. Special committees of the Conference were elected to deal with:

(1) Techniques of preparing abstracts.
(2) Relations with other services, and facilities for access to documents.
(3) Possible improvements in mechanical processing.
(4) Standardization.
(5) Physics and industrial technique.
(6) Pure and applied chemistry.
(7) Biology and medicine.
(8) Agriculture and applied biology.
(9) Future organization.

Committee No. 7 did not function; its failure being an indication of difficulties which arose through the holding of a UNESCO conference on abstracting in the special fields of biology and medicine shortly beforehand.

The Conference carried a large number of resolutions,* many being similar to those of the Royal Society's Conference. In almost all cases the recommendations were unanimous. The objectives of abstracting in science were seen to be:

(a) complete coverage by abstracts of all papers containing new information;
(b) adequate access to abstracts, for current information and back reference, for all scientists in all countries.

It was recommended that UNESCO continue its efforts to promote free interchange of scientific literature among countries, as a necessary basis. Attention was called to the gaps in abstracting which exist particularly in agriculture and in applied biology; and to the need for information about new scientific and technical apparatus and equipment. It was recommended that committees be created both on a regional basis and on a subject basis.

Regional Committees (or National Committees) might be established through the National Commissions of member States of UNESCO; free to correspond directly with each other, with UNESCO, with the International Unions, or with any other bodies. They should operate on a voluntary basis. Their primary function should be to study abstracting with a view to ensuring adequacy: in particular to see that

(a) scientific publications published in their own region are adequately listed and abstracted;
(b) scientists in their own region are adequately supplied with abstracts of papers published in foreign countries;
(c) the recommendations of the Conference are considered, and implemented where possible.

* Details may be obtained from the Commonwealth Office of Education, Box 3879, Sydney.

It was considered that such committees, in addition to the Subject Committees, would be more effective than the establishment of a single 'International Co-ordinating Office for Scientific Abstracting'—as originally proposed in Dr. Grivet's report and discussed by the Conference at considerable length. Because each country or region has its own specific problems, the existence of active regional committees seemed essential to the securing of eventual world co-operation. Preliminary action on such lines had already been taken in Australia through the A.N.R.C. and the C.S.I.R.O. following the 1948 Conference, and consultative action is now being taken by the Commonwealth Office of Education, through the Australian National Co-operating Body for Natural Sciences, regarding the Regional Committee recommendation of the Paris Conference.

It was considered that scientists and scientific publishing bodies may find it desirable to set up, in conjunction with any Regional Committees, a set of *Subject Committees* on an international level, to co-ordinate abstracting in the major fields of pure and applied science. At a later date it may be found desirable to establish committees for more specialized fields. As a result of previous action by UNESCO, a 'Co-ordinating Committee on the Abstracting and Indexing of Medical and Biological Sciences' had already been established, and it was recommended that this should be modified to form one of the Subject Committees. UNESCO should be invited to take steps, and offer facilities, to establish Subject Committees also in the fields of Physics and Engineering, Pure and Applied Chemistry, Agriculture and Applied Biology.

It was recommended that consideration be given to a proposal for publication, under the auspices of a single internationally controlled organization, of a single international general *Abstracting Journal for Physics*, both pure and applied, including astrophysics and the geophysical sciences, and for such branches of engineering as it may be appropriate to include; that some abstracts in this journal be published in English and others in French; and that it be in sections which might be published separately.

With regard to *Synopses*, it was recommended that each issue of any journal include synopses, in English or French at least, of all original articles contained; that the editor accept responsibility for their adequacy, whether prepared by the author or not; and that authority for republication be expressed. Such synopses might be used as abstracts where practicable. *The Guide for the Preparation of Synopses* prepared for the Royal Society (and given above) was suggested as a basis for discussion for the provision of a standard to be used by editors and authors.

Further recommendations were made upon the manner of presentation of abstracts, with standardization of rules; the publication of a periodical directory of indexing and abstracting services; the listing of periodicals currently abstracted; the periodical publication of lists of references and tables of contents in the literature of each field of science; the establishment of regional bibliographical centres and depositories for published and unpublished works, together with services for photographic reproduction; the provision of bilingual or polyglot dictionaries for all fields of science and technology, aided by the standardization of terminology; the development of standardized classification, to facilitate the interchange, storage and use of scientific knowledge; and the development and use of mechanical or electrical devices for the selection of documents.

A Provisional Advisory Committee of ten members (including Mr. J. E. Cummins of Australia)* was elected to act for one year It is convened directly by UNESCO; any succeeding committee that may be necessary will be convened in consultation with Regional and Subject Committees. The attention of UNESCO, WHO and FAO was drawn to the resolutions of the Conference; they were asked to provide for better distribution of abstracts in retarded areas, and to consider the provision of financial means needed to implement the general recommendations.

The first meeting of the Committee was held in Paris on 20 December 1949, and at the same time an informal meeting was held of the Joint Commission on Physics Abstracting which had been established in September by I.C.S.U.

News

'Journal of Agricultural Research'

The Australian Journal of Agricultural Research has been established by the C.S.I.R.O. in collaboration with the Australian Institute of Agricultural Science and the Australian Veterinary Association as a medium for the publication of research papers in the broad field of research on soils, plants, and domestic animals, covering the physical, chemical and biological aspects of the field. The editor will be Dr. N. S. Noble, and the Editorial Advisory Committee will include H. E. Albiston, L. B. Bull, H. C. Forster, G. W. Leeper and S. M. Wadham.

The journal will be issued quarterly, at a subscription of £1. 10s. a year. The first number appeared in January 1950. Communications should be sent to the Secretary, C.S.I.R.O., 314 Albert Street, East Melbourne, C.2, Victoria.

* The other members are S. Bhagavantam (India House, London); Pierre Bourgeois (Swiss National Library, Berne); Verner W. Clapp (Library of Congress, U.S.A.); G. M. Findlay (Editor, *World Abstracts*, London); H. R. Kruyt (Technical Scientific Organization, 's Gravenhage, Holland); L. H. Lampitt (chairman, Bureau of Abstracts, London); Bertil Lindblad (Stockholm Observatory); Miguel Ozorio de Almeida (Institut Oswaldo Cruz, Rio de Janiero); Jean Wyart (Faculté des Sciences, Paris).

The Royal Society Committees comprise:

Information Service Committee: Sir Alfred Egerton, Sir David Brunt, Sir Edward Salisbury, Sir Thomas Merton, T. E. Allibone, Prof. J. D. Bernal, Prof. G. L. Brown, Sir David Chadwick, J. E. Cummins, G. M. Findlay, J. E. Holmstrom, A. King, J. G. Malloch, C. F. A. Pantin, H. G. Thornton, D. J. Urquhart.

Abstracting Services Consultative Committee: G. M. Findlay (chairman), H. S. Bushell, R. B. Clarke, B. M. Crowther, J. E. Cummins, R. T Dawson, P. Grodzinski, B. N. Vaughan, Sir Herbert Howard, L. H. Lampitt, K. Headlam-Morley, Prof. R. T. Leiper, J. S. Robinson, L. J. Spencer, Prof. Samson Wright, C. Wilcocks, C. [illegible] Ashby.

The Gmelin Manual

The *Gmelin Handbook of Inorganic Chemistry* is published by the Gmelin Institute for Inorganic Chemistry and Allied Fields, of the Max Planck Society for the Advancement of Science. More than 32,000 pages have appeared. Work was recommenced in Clausthal in 1946, under Dr. E. Pietsch, producing from 2000 to 23,000 pages yearly. About half of the Eighth Edition is now completed. The work is dependent upon subsidies, notably from the American Chemical Society. The Manual endeavours to give a complete cover of the literature in the following fields: Chemistry (inorganic, physical, analytical, colloidal, electro-, heterogeneous equilibrium, technological, industrial); Corrosion and Passivity; Geology and Study of Deposits, Geochemistry, Mineralogy, Crystallography; Metallurgy, Science of Ore Dressing, Metallography, Iron and Steel, Non-ferrous Metals, Light Metals; Experimental Physics (nuclear and atomic, radioactivity, mechanical, thermal, optical, electrical and magnetic properties of substance); History of Chemistry.

The Editor of the Manual requests that authors and/or publishing bodies in Australia should send reprints directly to the Gmelin-Institut, (20b) Clausthal-Zellerfeld 1, Altenauer Strasse 24, Box 52, Germany.

'Nuclear Science Abstracts'

Nuclear Science Abstracts are prepared from U.S.A. Atomic Energy Commission documents which are not 'classified' for security reasons and from articles appearing in the published literature, pertaining to atomic energy. The abstracts are arranged according to broad subject categories, together with an author-index and a subject-index in each issue. The *Abstracts* are issued monthly by the Document Sales Agency, P.O. Box 62, Oak Ridge, Tennessee, U.S.A., at 25 cents an issue. Volumes are semi-annual, and each has a cumulated index. Volume 1 (July-December 1948) is available at $3.75, Volume 2 (January-June 1949) at $3.00, and Volume 3 (July-December 1949) at $3.00. The *Abstracts* are also available on an exchange basis.

Volume 3, No. 10, November 1949, as a typical issue, contains Abstracts No. 1784 to

No. 2037. Of these 253 entries, a 'Foreign Geographic Index' lists five as from Australia, one from Austria, one from Belgium, five from Canada, one from Cuba, one from Eire, six from France, 12 from Germany, 23 from Great Britain, one from India, 10 from Italy, six from the Netherlands, one from Poland, one from Portugal, five from Russia, one from South Africa, five from Sweden, one from Switzerland—the remaining 167 being from U.S.A.

The Technical Information Branch, Oak Ridge, also issues monthly lists of documents of the Atomic Energy Commission which are available for sale; List No. 15 appeared in November 1949. List No. 12 was cumulative to July 1949, and showed over 1100 titles, mostly at a price of five or ten cents.

'Road Abstracts'

Commencing with Volume 17 in January 1950, *Road Abstracts* is being published by His Majesty's Stationery Office instead of by the Institution of Municipal Engineers. It will be re-arranged and enlarged, and will appear in twelve monthly issues, with an annual name index and subject index. The *Abstracts* are prepared by the Road Research Laboratory of the D.S.I.R. and the Ministry of Transport from some 150 journals and from other sources. The price is to be 1*s.* for each issue and 1*s.* for the index; or an annual subscription of 14*s.*, including postage.

Indonesian Scientists

A *Guide of Scientists in Indonesia** has been issued by the Organization for Scientific Research (Koningsplein Zuid 11, Paviljoen, Djakarta). It gives a classified list of scientists in the Science Council for Indonesia (Natuurwetenschappelijke Raad voor Indonesië) and the Organization for Scientific Research (Organisatie voor Natuurwetenschappelijk Onderzoek, or 'O.N.O.'); in the University of Indonesia at Batavia, Buitenzorg, Bandung, Macassar and Surabaya; in Colleges at Buitenzorg; in various Institutes at Batavia, Buitenzorg, Bandung, Djocjacarta, Macassar, Medan, Pasuruan, Semarang and Surabaya; in Societies at Batavia, Buitenzorg and Bandung; and in Libraries at Batavia, Bandung, Macassar, Medan, Padang, Palembang, Pontianak, Semarang and Surabaya.

Brief information is given as to the Purpose, Administration and Publications of each establishment. About 800 names and positions are listed. It is intended to publish a supplement in 1950.

As a supplement to *Chronica Naturae* (This Journal, *10*, 111, 1948) the O.N.O. commenced in May 1949 to publish *O.N.O. News* (named in Dutch, *O.N.O. Mededelingen* from May 1949 to December 1949, and *O.N.O. Nieuws* from January 1950).

* O.N.O. Bulletin No. 3, November 1949. (64 pp., 7 photographs. 9½" × 12½".)

Ion Exchange Materials

Research chemists in Australia will be interested to learn that Cation and Anion Exchange Materials are available in Australia, as supplied by The Permutit Company Limited, of London. To lessen any delay in research caused by delivery time, a technical representative of the suppliers is available (243 Elizabeth Street, Sydney) to discuss materials for specific projects and give general advice.

Ion exchange is a unit chemical process in which a reversible interchange of ions between a liquid and a solid involves no radical change in the structure of the solid. After treatment of the liquid, the solid exchanger may be regenerated. Such a process has long been familiar for the softening of water, and is now finding an increasing variety of applications in the process industries and in research chemistry. These include a wide range, such as the purification of sugar solutions from dissolved mineral salts; removal of iron from lactic acid; preparation of pure acids from their sodium salts; recovery of copper from suprammonium waste liquors; isolation of alkaloids such as nicotine; isolation and separation of amino acids; concentration of aneurin from extracts of rice polishings; estimation of thiamine in urine; isolation and concentration of vitamin K1 from alfalfa; concentration of the gonadotrophic hormone in the Xenopus pregnancy test.

Wool Textile Research Laboratories

The Wool Textile Research Laboratories of the C.S.I.R.O. are organized in units at Sydney, Melbourne and Geelong. The Melbourne unit, under F. G. Lennox, is concerned with fundamental studies of the chemistry and biochemistry of wool. The Sydney unit, under V. D. Burgman, is to deal with physics and engineering problems connected with wool fibres. The Geelong unit, to which M. Lipson has just been appointed, will operate in the field of wool technology and will assist industry in applying the results of the basic investigations undertaken at Melbourne and Sydney.

Dr. Lipson is a graduate of the University of Sydney who was employed in the wool industry before joining the C.S.I.R. He was jointly responsible for the Freney-Lipson shrinkproofing process. After the war he was awarded an International Wool Secretariat Fellowship at the University of Leeds and later visited research institutes in Europe and America. Since his return to Australia he has been continuing research on the effects of synthetic resins upon wool.

Science in Yugoslavia

The Foreign Minister of Yugoslavia, Edvard Kardelj, addressed the Slovene Academy of Sciences and Arts on the occasion of his recent election as honorary member. He stated that historic-materialist social science today finds itself in a state of stagnation, under the pressure of Soviet practice. He referred to

the tendency to substitute subjective desires and needs for objective truth, and to proclaim 'eternal untruths on the basis of quotations and construed dogmas, which means passing from dialectical materialism to metaphysics'. 'This explains why contemporary social science has yielded little in seeking the objective laws of development of the socialist system. Contemporary Soviet science, for example, defends the opinion that the entire scope of socialist development is wholly exhausted in the documents of the Soviet state; whose leaders are capable of offering to the world absolute truths which no advance of science or practice can sway.'

'Science is the property of mankind as a whole, while the leading role belongs to that science which at the given time contributes most to the progress of mankind as a whole; that is, which at that time contributes most to the further progress of socialism and socialist democracy. Science in Yugoslavia must serve the people and its social, economic and cultural advancement; in a people's socialist State, genuine science is a strong supporter of that State.'

'We hold that our men of science must be free to create; for without the struggle of opinions and without scientific discussion, criticism, and the testing of theoretical postulates in practice, there can be neither progress in science nor a successful struggle against reactionary conceptions and dogmatisms in science. Our scientific criticism must not be destructive or intimidating, because such criticism demoralizes and deadens: it must be constructive and encouraging towards all efforts whose objective is scientific truth.'

The International Unions

The Executive Committee of the International Council of Scientific Unions met at Copenhagen on 13 September 1949. A new commission, on Physics Abstracting, was established to represent the needs of the user, opposite the Subject Committee of UNESCO on Physics and Engineering Abstracts.* It is of ten members, drawn from I.U.P.A.P., I.A.U., I.G.G.U., U.R.S.I., I.U.Cr., I.U.T.A.M. and I.U. History of Sciences. The Commission on Radiobiology, formerly within the I.U. Biological Sciences, has been made a Joint Commission drawn from I.U.B.S., I.U.P.A.P., and I.U.C. A Joint Commission on Physico-Chemical Constants and Data was established, from the I.U.C. and I.U.P.A.P., to replace two former commissions of the I.U.C.

The V General Assembly of I.C.S.U. met at Copenhagen on 14-16 September 1949. It was decided to classify the existing Unions† in two groups, as:

General: Astronomy, Biological Sciences, Chemistry, Geodesy and Geophysics, Physics.

Specialized: Crystallography, Geography, History of Sciences, Theoretical and Applied Mechanics, Radio-Science.

* See above, pages 138-9.

† Australia adheres to Astronomy, Biological Sciences, Chemistry, Geodesy and Geophysics, Physics, Crystallography, Radio-Science. Australia does not adhere to Geography, History of Sciences, Theoretical and Applied Mechanics.

I.C.S.U. and UNESCO

The V Assembly passed a resolution which, after a preamble, stated that it 'deeply regrets that the continuation of fruitful co-operation between UNESCO and I.C.S.U. is seriously endangered by the resolution on the subject of grants-in-aid adopted by the Executive Board of UNESCO in June 1949;* fears that su a a resolution would well deal a serious blow to work now in full progress, of which the deep significance for international understanding should suffice to place it high among the activities which further the claims of UNESCO; and expresses the hope that the IV General Conference of UNESCO will decide in favour of an unbroken and boldly conceived continuation of the existing Agreement with I.C.S.U., an Agreement which has fostered so successfully . . . the spirit of international co-operation in the domain of science'.

Sir David Brunt, the Secretary of the Royal Society, was nominated to present this resolution to the Assembly of UNESCO. On the motion of the British delegation, seconded by the Chinese delegation, the General Assembly of UNESCO (meeting in Paris, September-October 1949) resolved 'considering the report of the Director-General on the development of relations with the I.C.S.U., that it expresses its satisfaction with the results achieved in the furtherance of UNESCO's constitutional objectives in the scientific field under the existing Agreement, and instructs the Director-General to continue co-operation with, and to maintain financial assistance by means of grants-in-aid to, the I.C.S.U. in 1950, on the basis of the existing Agreement'.

It was decided by UNESCO to secure the services of an expert officer to obtain detailed information concerning arrangements entered

* The resolution stated that the Executive Board recognized that financial assistance extended to non-governmental organizations in the form of grants-in-aid and payments under contract had contributed towards the re-establishment of international relations after the war; wished that in future the fullest possible information should be given on the purposes for which the funds have been used; and recognized the need of re-examining the policies governing such relations. The resolution went on to recommend that, in implementing the present directives (up to the V Conference in May 1950) the Director-General should apply the principles that:

(a) financial assistance should increasingly be given in the form of contracts for projects directly related to the programme of UNESCO;
(b) grants-in-aid be given only in a limited number of cases; in particular with the purpose of assisting new international organizations sponsored by UNESCO;
(c) caution should be exercised in promoting the creation of new international organizations.

into with non-governmental agencies. The results of prolonged verbal questionnaires conducted by this officer, followed by printed questionnaires, will be presented to the V General Conference of UNESCO in Florence in May 1950. The Executive Board of UNESCO, meeting in Paris, 24 November to 2 December 1949, passed grants-in-aid to I.C.S.U. for 1950 amounting to $177,079, and approved a total virement of $16,540 from 1949 to 1950.*

I.U. Theoretical and Applied Mechanics

The Bureau of I.U.T.A.M. met in Paris on 5-6 May 1949. Besides the International Committee for the Congresses of Applied Mechanics, the adhering bodies were Great Britain, Hungary, France and Czechoslovakia; while applications were pending from Norway, Belgium, Italy and U.S.A., and were expected from Holland and Switzerland. It was decided to take steps for arranging a General Assembly in Rome in March or April 1950, if possible to be combined with a colloquium on Plasticity. It was decided to apply to UNESCO for support for an enlarged edition of the *Index of Mathematical Tables*, to be available to all workers.

I.U. Pure and Applied Chemistry

At the XV Conference of the I.U.C., held in Amsterdam on 5-10 September 1949, it was decided to divide the Union into six Sections —Physical Chemistry, Inorganic Chemistry, Organic Chemistry, Biochemistry, Analytical Chemistry, Applied Chemistry—each with a large measure of autonomy. It was noted that excellent results have been obtained by the Commission on Chemical Encyclopaedias and Documentation, and its Advisory Council on the *Gmelin* and *Beilstein* encyclopaedias; volumes of the second supplement of *Beilstein* are now coming into the hands of the organic chemists.

National University

Dr. W. E. H. Stanner, who has been appointed Reader in Comparative Social Institutions in the Department of Anthropology in the Research School of Pacific Studies, is a graduate of the University of Sydney and of the London School of Economics. He was with the expeditions to North and Central Australia in 1932 and 1934-35, and was engaged on research in Kenya in 1938-39, in the South-West Pacific Islands in 1946-47, and in Uganda and Tanganyika in 1948-49. His published works include *The South Seas in Transition* and a *Report on Social Science in East Africa*: a book on *The Economics of the Australian Aborigines* is nearing completion. Before taking up duty in Canberra, Dr. Stanner will spend time in East Africa completing work there.

University of Melbourne

Associate Professor Erich Heyman, who had been on leave in England and was travelling through the United States of America on a Carnegie grant to return to Australia, died in his sleep on 23 November at International House in the University of Chicago. He had been lecturer in Physical Chemistry at Frankfurt up to 1934 and came to the University staff in Melbourne in 1936.

The following appointments have been made: G. C. Gaze, as senior lecturer in Mechanical Engineering; D. Broadbent, as lecturer in Electrical Engineering; J. Gani, as lecturer in Mathematics; Diana Dyason, as lecturer in General Science; A. S. Watt, of Cambridge, as senior lecturer in Botany for one year. J. C. Woodhouse has been appointed Academic Secretary, with B. C. J. Meredith as his assistant.

The following members of staff are on leave of absence abroad: Professor T. M. Cherry, to Trinity College, Cambridge; Associate Professor Thornton Smith, to London and Zurich; Dr. F. Laszlo, to Great Britain and Switzerland; Dr. A. S. Buchanan, to Oxford; Dr. F. Loewe, to the French Antarctic Expedition.

The following benefactions have been received: £1,500 from Norman Myer, for physiological research for a period of three years; £100 from the Henry Berry Fund for visual aids for semi-blind students; and sums totalling £393 from eight other donors.

University of Adelaide

Recent appointments include that of J. P. Morgan as Reader in Mining Engineering. He is a diplomate of the Broken Hill Technical College and a graduate of Adelaide, where he was awarded the Francis A. Govett Scholarship in 1942.

University of Sydney

The inaugural John Irvine Hunter Memorial Oration was delivered on 31 January 1950 by Professor Raymond Dart of the Chair of Anatomy in the University of Witwatersrand. The title of the Oration was 'The Fossil Man Apes of South Africa and Their Bearing on Human Evolution'.

International Scientific Conferences

Additions and modifications to the list published in This JOURNAL, *12*, 73, October 1949.

1950

May 22 - June 16 — V General Conference, UNESCO. Florence.
June 10-17—Ornithological Congress. Uppsala.
June 14-17—I.U.P.A.P., Colloquium on Ultra-Acoustics. Rome.
June 27-28—I General Assembly, I.U. Theoretical and Applied Mechanics. Rome.
July 7-10—General Assembly, I.U. Biological Sciences. Stockholm.
July 10-15—I.U.P.A.P., Colloquium on Semi-Conductors. Reading.
July 16—ICSU, Joint Commission on Radio-biology. Paris.
July 17-18—ICSU, Joint Commission on Radio-active Standards and Units. Paris.
July 23-29—VI Congress of Radiology. London.
July—ICSU, Joint Commission on Spectroscopy. London.

* Previous grants-in-aid were: 1947, $251,959; 1948, $238,374; 1949, $256,425·7.

August 14-21—VI Congress, I.U. History of Sciences. Amsterdam.
August 22—Assembly, Academy of the History of Sciences, Amsterdam.
August 15-28—XVI Congress of Physiology. Copenhagen.
September 4-6—ICSU, Joint Commission on the Ionosphere. Brussels.
September 4-8—Congress of Cell Biology. Yale.
September 11-12—UNESCO, Meeting of the Associations for the Advancement of Science. Paris.
September 11-23—IX Assembly, Union of Scientific Radio. Berne.
September 12-14—I.U.T.A.M. and I.G.G.U. Symposium on the Motions of the Earth's Crust. Washington.
October 2—Pan-American Institute of Geography and History. Santiago.
October 4-11—Council for the Exploration of the Ocean. Edinburgh.

1951
February—IV Congress on Large Dams. New Delhi.
June 27-July 3—II Assembly, I.U. Crystallography. Stockholm.
August 8-15—Assembly, Int. Astronomical Union. Leningrad.
August 21-September 1—IX Assembly, I.U. Geodesy and Geophysics. Brussels.
September 8-17—XII Congress of Pure and Applied Chemistry; XVI Conference, I. U. Pure and Applied Chemistry. Washington and New York.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (a) Original Work; (b) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

A Modified Form of the Allen Hydrogen Arc

A continuous source of radiation is indispensable for the study of absorption spectra, especially of substances in the form of vapour, where discrete bands are most frequently observed. For the ultra-violet region the most useful source is the hydrogen arc. Many forms of this arc have been constructed from time to time, and they have become a commercial article, the majority built of glass with some sort of transparent (to ultra-violet) window. The power required to operate these arcs is usually small, and the intensity of the radiation not very great. This is a disadvantage when they are used in conjunction with, say, a grating spectrograph, because the time of exposure of the photographic plate has to be very prolonged. Allen (1941) has described the construction of a high-intensity hydrogen arc, built almost entirely of metal. In our attempts to reproduce one of these models we encountered certain difficulties which we overcame in different ways. We thought that a description of the final form our modification took would be of interest and value to others who may be immediately concerned with developing a continuous ultra-violet source.

Our arc differs from the original mainly in the nature of the vacuum seals, in additional cooling devices, and in its inverted form. It differs also in so far as Allen's arc was designed as a separate unit, whereas we found it more useful to retain its connexion to the vacuum system. The dimensions are the same as those described by Allen, but the apertures in the cathode and anode were changed to a rectangular form, ⅛-inch to ¼-inch, this being more suitable for the slit of the Hilger 185-grating spectrograph. The circular aperture might perhaps be more suitable for a smaller spectrograph.

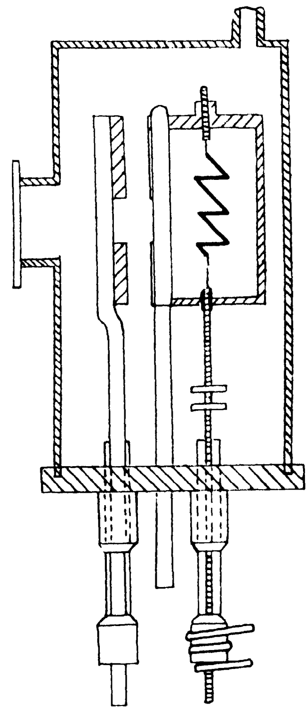

Figure 1.

The commercial Kovar seals described by Allen were not available, so that substitutes had to be prepared. For this purpose, three lengths of pyrex glass tubing 3½ inches long, ⅜-inch external diameter, were abrased for about ¾-inch at each end with emery paper, thoroughly cleaned with chromic acid, etc., and coated on the abrased part with a thin coating of a commercial silvering solution, 'Elargol'. The silver obtained by reduction at a gentle heat is carefully burned in at a dull red heat, and up to six more coats of silver applied in the same way. The silver layer is

then coated electrolytically with copper, and the copper is tinned carefully with tin-silver solder. Too much heat will cause the silver to lift off the glass. The tin-silver solder has the advantage of a reasonably low melting-point. The method of soldering the tube to the copper cap, C, and the bush, B, will be understood from Figure 2. The whole success of the operation depends on accurate soldering, as the seal so constructed has to be vacuum tight. A section of the assembled arc is shown in Figure 1. It should be compared with the diagram in Allen's original paper. The seals have been made below the arc, which is therefore inverted in respect to Allen's design. We found that the heat rising up, especially in hot weather, would tend to soften the solder on the seals. As it is, we found it advisable to put an additional cooling coil round the cap of the cathode seal, as shown in Figure 1.

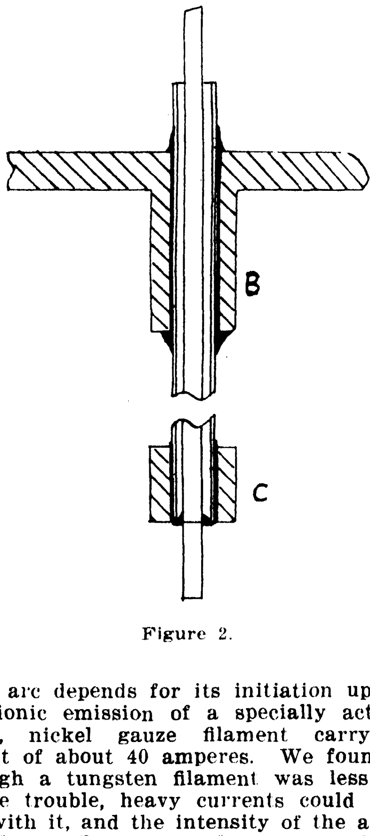

Figure 2.

The arc depends for its initiation upon the thermionic emission of a specially activated, coated, nickel gauze filament carrying a current of about 40 amperes. We found that although a tungsten filament was less likely to give trouble, heavy currents could not be used with it, and the intensity of the arc was much less. The original form of the filament described by Allen was adopted, the nickel gauze being coated with a thick layer of calcium and strontium carbonates dispersed in an amyl acetate binder. The filament is gradually activated under high vacuum by passing a current of about 20 amperes at one volt, gradually increasing the current to a maximum of 40 amperes. The activated filament is destroyed by the admission of air, and must then be entirely replaced. The arc works with a pressure of hydrogen up to about 6 mm. Commercial hydrogen from a cylinder is not satisfactory, and must be purified by passing it through palladium. The arc works most satisfactorily on a current of 5-10 amperes, but the current must not be increased beyond this, as too many lines, mainly due to copper and nickel, appear in the continuum.

We are indebted to members of the Radiophysics Division of the C.S.I.R.O. for much helpful advice.

T. M. DUNN,
R. A. DURIE,
T. IREDALE.

Physical Chemistry Laboratory,
University of Sydney.
November 1949.

Effect of Cryptopleurine on Cell Division

Cryptopleurine has been one of the substances studied in an investigation of the effects and mode of action of a number of inhibitors on cell division. In our material, the effects of this substance are different from those recently reported by Barnard (1949), being somewhat similar to the effects of monacrin and quite different from those of colchicine.

When fertilized developing oyster eggs at the first cleavage metaphase and the two-cell stage are exposed to concentrations of the alkaloid varying from 10^{-3} to 5×10^{-6}M, the following effects may be demonstrated: (a) the normal rise of respiration with development is abolished, the respiration remaining constant for some hours; (b) the eggs are arrested in the two-cell stage, the nucleus undergoing a progressive increase in diameter. Some lobulation of the nucleus is frequent, owing to the intrusion of cytoplasmic bands.

In sections cut from eggs exposed to cryptopleurine of 10^{-4}M concentration, the nucleus, apart from its hypertrophy, has a similar appearance to the normal resting nucleus of this material. After some two hours exposure, prophase chromosomes appear which seem to be considerably longer than normal. By the end of three hours, at which time the untreated eggs are hatching as ciliated larvae, condensed chromosomes of approximately normal metaphase length are seen scattered at random in the hypertrophic nucleus of a proportion of the cells. No observations have been made on the effect of longer exposure times.

The first maturation metaphase spindle, which persists in those eggs which have not been fertilized, is not affected by cryptopleurine.

Colchicine causes arrest at the metaphase following its application. The chromosomes

become supercontracted and, while no spindle fibres develop, little scattering of the chromosomes occurs in the first few hours of exposure. The pre-existing first maturation spindle disappears under the influence of colchicine, with subsequent deorientation of the bivalents.

The effect of cryptopleurine on yeast growth is also different from that of colchicine. The latter, although it penetrates the yeast cell, has no effect on yeast growth. The former, which is adsorbed by the yeast cell, suppresses growth at a concentration of 10^{-6}M, some delay still being demonstrable at 10^{-7}M.

In a comparison of the lag phase metabolism of normal and cryptopleurine-treated yeast, it has not been possible to demonstrate any significant differences in N or P uptake, carbohydrate synthesis, or respiration. Preliminary experiments have failed to show any difference in ribonucleic acid synthesis.

Even with strong concentrations of this substance it has not been possible to demonstrate, over four-hour exposure periods, any significant change in streaming or viscosity in the cytoplasm of Elodea leaf cells, which implies that there is little effect on protoplasmic structure.

It is evident that the mode of action of this compound is complex, and the explanation of the difference in effect on oyster eggs and onion roots must await further study.

There is some similarity between the action of cryptopleurine, which has vesicant properties (De La Lande, 1948), and that of the nitrogen mustards (Bodenstein, 1947). The latter cause an almost complete cessation of mitosis in embryonic Amblystoma ectoderm, with a slow hypertrophy, and later fragmentation, of the nucleus. An interaction between the mustard gases and nucleoproteins and nucleic acids has been found (Berenblum and Schoental, 1947; Gjessing and Chanutin, 1946). The possibility that cryptopleurine has a similar effect is being studied.

Thanks are due to Professor V. M. Trikojus, University of Melbourne, for supply of cryptopleurine, and for suggesting its study. The work has been aided by a grant from the University of Sydney Cancer Research Fund.

K. W. Cleland.

University of Sydney,
30 December 1949.

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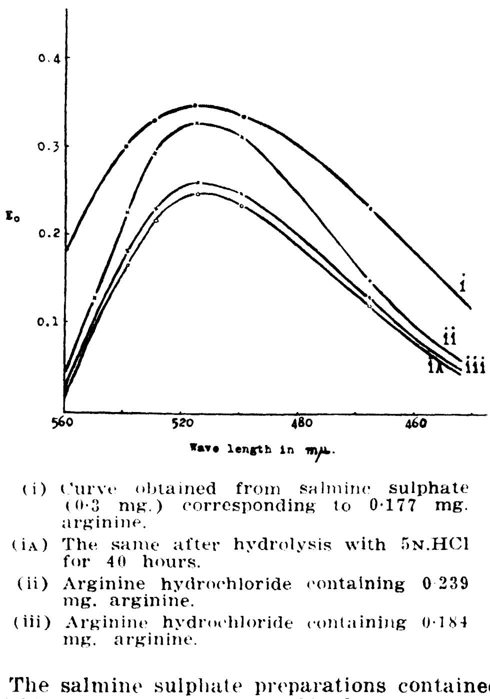
The Question of Arginine Linkage in Salmine

During the course of an investigation of the breakdown of salmine by an enzyme present in blood serum, the reaction was followed by the estimation of arginine, using the Sakaguchi test as modified by Albanese *et al.* (1946). When salmine sulphate was used as reference substance, the results compared favourably with estimations of non-protein nitrogen. However, when salmine was replaced by arginine as standard, theoretically impossible figures were obtained. In order to find the cause of these varying results, the Sakaguchi reaction was carried out simultaneously on salmine sulphate (Lilly), its acid hydrolysis products, and arginine hydrochloride. The optical densities of the colours obtained were measured in a Beckmann spectrophotometer.

Figure 1.
Absorption spectra of Sakaguchi reaction products.



(i) Curve obtained from salmine sulphate (0·3 mg.) corresponding to 0·177 mg. arginine.
(iA) The same after hydrolysis with 5N.HCl for 40 hours.
(ii) Arginine hydrochloride containing 0·239 mg. arginine.
(iii) Arginine hydrochloride containing 0·184 mg. arginine.

The salmine sulphate preparations contained 22·04% nitrogen (Micro-Kjeldahl), and 58·9% arginine, when estimated by the flavianate technique of Vickery (1940). The arginine hydrochloride employed contained 25·7% total nitrogen, from which a purity of 96·5% was calculated.

From the Figure, it would appear that the salmine sulphate appeared to contain 79·7% arginine. After acid hydrolysis, however, the arginine value dropped to 60%. A value of 79·7% arginine is theoretically impossible, because if the substance were pure arginine sulphate it could not contain more than 78% arginine. On the other hand, the value for arginine found in the hydrolysate agreed reasonably well with the gravimetric estimation of arginine as flavianate.

It is interesting to note the difference in the shape of the salmine and arginine curves. Although the maximum absorption takes place at a wave length of 515 mμ in all preparations, yet, when corrected for the blank, it is apparent that, in addition to the chromophoric groups in the salmine molecule, there are auxo-chromic groups enhancing the arginine colour value.

The discrepancy between the results raised the question of the linkage of arginine in the salmine molecule. The only reference to the arginine content of basic proteins, as estimated by the Sakaguchi colour reaction, was found in a paper by Roche and Blanco-Jean (1940), in which it is stated that approximately 30% of the arginine present in the molecule is detectable with the colour reaction; and from this result it is concluded that the bulk of the arginyl groups is present in combined form, the linkage occurring in addition to peptide bonds through the guanidine radicle. Roche carried out the test in the cold, while we worked at 20° C. The Sakaguchi test is performed in two stages. The mechanism of the first phase, namely the α-naphthol reaction with arginine, is not understood; but it is well known that hypobromite, in the absence of α-naphthol, liberates nitrogen from guanidine derivatives. It is probable that the reaction rates of the two phases are markedly different. In order to obtain greater intensity of colour, it is necessary to work at room temperature. By changing the experimental conditions, it is therefore possible to obtain differences in colour intensity, from which varying arginine values are calculated.

From these results, it would appear that the α-naphthol-hypobromite reaction can be applied for quantitative estimation of arginine in hydrolyzed protamine, but it is not applicable to protamine itself and it is unsuitable for problems in protein constitution. A study of the hypobromite reaction on salmine and its breakdown products offered more promising results.

The reaction was carried out in Warburg vessels, under a variety of experimental conditions. Arginine liberated 44% of its total nitrogen as gas. Under the assumption that the free guanidine groups of salmine sulphate would behave similarly, then 78% of the arginine present in salmine was found as uncombined guanidine groups before hydrolysis. Following acid hydrolysis, 96% of the arginine nitrogen could be accounted for by the NaOBr reaction.

As pointed out by Chinard (1948) the hypobromite reaction is not specific for the guanidine group of arginine. But in the case of salmine, the only other radicles are those of α-amino acids and they do not evolve nitrogen by this treatment. The results suggest that the hypobromite reaction gives a picture nearer the truth than the Sakaguchi reaction.

The question of the arginine linkage in basic proteins has been discussed by several workers. Kossell and Kennaway (1911) nitrated protamines. On hydrolysis, nitro-arginine was isolated and it was therefore deduced that the guanidine group was free and not in combination. Observations suggesting that some of the guanidine groups are linked to other portions of the protein molecule, however, have been made by Sakaguchi (1925), Goldschmidt *et al.* (1930), and by Chinard (1948). H. S. Simms (1930) also has suggested from titration curves that arginine groups may be linked in two different ways in proteins. Finally, Roche and Mourgue (1946) found that baryta does not liberate the expected amount of urea from salmine, and they concluded that, in the intact protein, some of the guanidine groups are present in bound form.

From the results obtained by the use of the hypobromite reaction, it would appear that four-fifths of the guanidine groups of salmine are free, and one-fifth is not only combined in the usual peptide linkage but also substituted in the guanidine radicle.

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Transmission of a Recently Isolated Mycobacterium to Phalangers (Trichosurus Vulpecula)

In a survey of the pathogenicity of *Mycobacteria* in marsupials, the common phalanger or possum (*T. vulpecula*) was found to be highly susceptible to infection with *Mycobacterium tuberculosis* (Bolliger and Bolliger, 1948). Subsequently, phalangers were inoculated with material from a leproma showing numerous acid-fast bacilli. No evidence of infection has as yet been observed in these animals.

Later it was decided to investigate the pathogenicity in possums of a *Mycobacterium* isolated from an indolent ulcer of the leg occurring in a Sydney patient. Details of this case

* Working under a grant from the National Health and Medical Research Council.

have not yet been reported; but both the lesion and the organism appear to resemble those described by McCallum, Tolhurst, Buckle and Sissons (1948). Inoculations of possums by the subcutaneous or intraperitoneal route were made with acid-treated material from the ulcer and with a suspension of *Mycobacteria* isolated in culture from the ulcer. Lesions were established in these animals and the infection was found to be transmissible through a series of phalangers. For example, acid-fast bacilli, present in a skin lesion produced in a phalanger four months after a single subcutaneous administration of acid-treated material from the original human ulcer, was transmitted to six additional possums of which five also developed skin ulcers within two to six months. These lesions started as a localized oedematous subcutaneous swelling followed by skin ulcerations which in two instances healed again. All the early ulcerated areas contained acid-fast bacilli at some stage as shown by bacteriological examination. The lesions developed at varying sites, usually independent of the route or place of injection.

The non-healing ulcerations increased rapidly in size and led to sloughing, weeping, raw areas, ultimately exposing and even destroying the underlying muscles. At this later stage the ulcer areas usually contained numerous acid-fast bacilli. The surrounding tissue up to a distance of several centimetres was swollen and oedematous and in some cases there was also generalized oedema and some ascites.

Another phalanger, injected intraperitoneally with an emulsion of cultured organisms, developed a subcutaneous cyst on the knee. The cyst fluid was swarming with acid-fast bacilli, but no other organisms could be demonstrated. Repeated drainage, however, caused the disappearance of the cyst. Several months later a new generalized swelling formed on the right front paw, ulcerated, and then disappeared. Sometime later a new lesion formed on the tail of the animal.

Two uninoculated animals, housed for periods of two and six months respectively in the same room as animals showing cutaneous ulcers, developed severe skin ulcers. An additional uninoculated animal showed evidence of widespread progressive infection with the relevant *Mycobacterium*, six months after a few days of contact with ulcerated phalangers.

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A Thermostable Inhibitor of Haemagglutination Found in Animal Tissues

In 1947 Francis described a thermostable serum inhibitor of haemagglutination by heated LEE virus. It was found later that a thermostable inhibitor was present in tissue extracts as well as in serum. This tissue inhibitor was titrated in the present study by a method equivalent to that described by Anderson for serum inhibitor: extracts of tissues were made by grinding in 0·85% sodium chloride solution at bench temperature and centrifuging.

An examination was made of the amount of thermostable inhibitor readily extractable from ground tissues of the following common animals: mouse, rat, guinea pig, rabbit, sheep, cat, ferret and man. The following tissues in general yielded little inhibitor: alimentary tract wall from cardia to rectum, lymph node, thyroid, suprarenal and uterine mucosa. A high titre of inhibitor was found in a few tissues in each species, and an outstanding titre was found in the sublingual gland of the mouse, the combined submaxillary and sublingual glands of the ferret, the submaxillary gland of the sheep, and the human sublingual gland. Results of interest are given in Table 1, the titres being expressed in terms of the wet weights of the tissues. The inhibitor in all cases was susceptible to inactivation by the

Table 1.
Titres of thermostable inhibitor in animal tissues.

	Guinea Pig	Human	Ferret	Mouse	Sheep	Rabbit
Sublingual gland	—	35,000	—	100,000	—	2,000
Submaxillary gland	700	2,000	150,000*	3,000	500,000	700
Parotid gland	1,250	1,500	500	500	250	700
Nasal mucosa	10,000	2,600	3,000	400	350	1,800
Bronchial wall	4,500	—	800	1,000	1,000	2,500
Peripheral lung parenchyma	4,000	2,500	2,000	1,000	4,000	1,500
Duodenal mucosa	100	600	150	400	350	800
Ovary	5,000	4,000	5,000	1,200	—	4,000
Serum	1,200	1,000	1,000	100	500	1,000

* Combined sublingual and submaxillary gland.
– Test not done.

cholera red cell eluates (R.D.E.) prepared in 1947 according to the method of Burnet and Stone.

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Reviews

Agriculture

PROCEEDINGS OF THE FIRST COMMONWEALTH CONFERENCE ON TROPICAL AND SUB-TROPICAL SOILS, 1948. (Commonwealth Bureau of Soil Science, Technical Communication No. 46, 1949. 235 pp. Obtainable from the C.A.B. Liaison Officer, 314 Albert Street, East Melbourne, C.2, Victoria.) Price £1. 11*s*. 3*d*.

The volume is especially valuable because so little descriptive work on tropical soils has been collected in book form before. The descriptive section provides an opportunity for comparing Australian soils with their relatives in Africa. The section on classification also has useful material in spite of the confused state of the subject. The shrewdest explanation of this confusion comes from G. W. Robinson (p. 132), to the effect that soil classification is a philosophical problem and that pedologists have unconsciously followed Plato in accepting the existence of 'ideal' soil groups, of which all observed examples are but particular manifestations. A great deal of thought is still needed to make a good classification, but the conference is bound to lead to fresh efforts.

The papers and discussions are presented in four sections: Descriptions of predominant soils of the tropics and sub-tropics; Classification; Fertility problems; Soil erosion and miscellaneous problems. Belgian, Dutch, French Colonial, and U.S.A. contributions to the conference are included. Tropical Australia is dealt with in a paper by C. G. Stephens.

The highly leached soils of hot and wet climates have their own problems of fertility, some of which are mentioned in the third section. Three of the most valuable contributions in the last two sections of the book are 'The Design of Rotation Experiments', by F. Yates; 'The Soil Requirements of the Banana', by J. Baeyens, dealing mainly with the Belgian Congo; and 'The Cereal-Fallow Rotation in Cyprus', by P. A. Loizides. This last paper belongs to temperate rather than tropical agriculture, and puts forward surprising evidence of the accumulation of total nitrogen in soils during a fallow period.

G. W. LEEPER.

Bacteriology

BACTERIAL METABOLISM. Third edition. By Marjory Stephenson. (London, etc.: Longmans Green, 1949. 398 pp., numerous tables and text-figs. 5½″ × 8½″.) Price, £2. 9*s*. 6*d*.

By the time a book reaches its third edition, most of its faults should have been corrected. This is certainly true of the late Dr. Marjory Stephenson's standard work, *Bacterial Metabolism*. All that remains for the reviewer is to mention the latest features and the many new topics which appear.

It has fewer pages than the second edition, yet much more material has been included by reducing the width of the margins. Over a hundred new references have been cited, thus bringing the total to almost nine hundred. There are more tables and figures, and one photograph has been added.

In the introductory chapter, an historical review of the subject of bacterial metabolism has been enriched by some pointed quotations from Pasteur. The brief discussion on cell energetics, which always seemed out of place here, has been omitted. Very little alteration has been made to the chapter on respiration. As an illustration of the value of tracer carbon in elucidating biochemical mechanisms, recent work on the reduction of carbon dioxide to methane or acetic acid has been added. The microbial reduction of nitrates and tetrathionates is also included.

The subject of polysaccharides remains unaltered except for a brief mention of the breakdown of hyaluronic acid. It is pleasing to see that more use has been made of the Haworth formulae for carbohydrates. Steps in the production of alcohol from carbohydrates are illustrated more clearly than formerly in the chapter on fermentation. The concept of high-energy and low-energy phosphorus bonds is discussed. Recent work on the origin of various organic acids and modern ideas on the Pasteur effect have been summarized.

The old heading, 'The Decomposition of Proteins', has been replaced by the title 'Nitrogen Metabolism', so as to include recent research on the synthesis of proteins such as bacterial toxins and antibiotics, and the synthesis of tryptophane using mutants of the mould Neurospora. Other interesting topics include the decomposition of arginine and the assimilation and metabolism of amino acids by Gram-positive bacteria. The chapter entitled 'The Metabolism of Nucleic Acid and its Derivatives' has been greatly enlarged to cover new ideas on the role of nucleic acids in bacterial nuclei and the Gram layer, and changes in the nucleic acid content of cells throughout the growth cycle.

Growth and nutrition studies have been largely concerned with the role of vitamins in bacteria to the neglect of mineral nutrition. One of the rare typing errors of the book occurs in this chapter, where the symbol Mb has been used by mistake for molybdenum. Much is known about the use of sugars and

amino acids by bacteria, but so far little work has been done on the breakdown of less readily available sources of carbon and nitrogen encountered by soil and water bacteria.

In discussing nitrogen fixation the mistaken idea has been repeated, that the free-living bacteria, *Azobacter* spp., are widely distributed in soils. The use of hydrogen as diluent has invalidated much of the earlier work on the effect of oxygen and nitrogen pressures upon the rate of fixation of nitrogen by bacteria. At present there is no known connexion between the occurrence of haemoglobin in the root nodules of leguminous plants and the mechanism of nitrogen fixation.

The chapter on autotrophic bacteria has hardly been altered, thus indicating the lack of interest in these organisms during the past decade. It is doubtful whether some of the bacteria mentioned can still be classified as autotrophs, since they are able to utilize some organic compounds. The subject of bacterial photosynthesis remains unchanged.

The final chapter, entitled 'Enzyme Variation and Adaptation', has been altered considerably. It now includes such topics as artificial production of mutants, cyanide yeasts; a sulphapyridine-induced mutation of Pneumococcus type I; effect of Fe-deficient media on enzyme production; induced sulphonamide resistance; mechanism controlling polysaccharide production in type III Pneumococcus; the relation between adaptive enzyme formation and growth; the influence of oxygen tension on the production of aerobic and anaerobic enzyme systems; the effects of pH, temperature, and carbohydrates on enzyme production.

The whole book has been so enlarged and improved, in order to keep pace with the rapid strides made in bacterial metabolism, that previous editions should be kept in libraries only for historical interest.

F. SWABEY.

Biochemistry

VITAMINS AND HORMONES: Advances in Research and Application. Volume VI. Edited by Robert S. Harris and Kenneth V. Thimann. (New York: Academic Press, 1948. 435 pp., numerous tables and text-figs. and cumulative index to Volumes I-V.) Price, $7.80.

Volume VI of the *Vitamins and Hormones* series contains eight articles contributed by twelve authors. Three articles deal with specific vitamin groups: pteroylglutamic acid and related compounds; the K vitamins; and the function of B vitamins as plant hormones. Points of interest in these accounts are: the absence of effect, in higher animals, of variations of the glutamic acid side chain of pteroylglutamic acid, but its importance in micro-organisms; evidence that the inhibitory effect of substances chemically similar to the K vitamins is not the usual competitive reaction effect; the fact that although plants can synthesize B vitamins, this property is not possessed to an equal degree by all their tissues, so that difficulties of translocation may lead to local deficiencies.

Another article deals with the action of vitamins as pharmacological agents. Attention is usually focused on the effects of deficiencies. When administered even in gross excess, all but two fat-soluble vitamins (A and D) seem to be of extremely low toxicity. Lack of precise information as to requirements under different physiological conditions, however, such as pregnancy, or in disease, often complicates the interpretation of results.

The assessment of human nutriture or the state as distinguished from the process of nutrition, is discussed in relation to the various essential constituents of food, and various bodily measurements or properties. The article deals mainly with classification and nomenclature, which in some instances seem rather arbitrary.

The vitamin requirements of several widely differing organisms are dealt with: various species of bacteria, yeasts, and moulds, and two species of mammals. Micro-organisms are in sharp contrast to the higher organisms, in their independence of fat-soluble vitamins and their ability to synthesize many water-soluble vitamins from simple nitrogenous compounds. The studies on the cotton rat and the hamster are of special interest, as the vitamin requirements of these animals are now well enough understood to allow of their being bred on purely synthetic diets. The essential nature of a number of water-soluble vitamins for the hamster has not been demonstrated, but it is of interest to notice that this animal requires a dietary source of vitamin K.

The last article deals with the control of electrolyte, especially sodium and potassium, and water metabolism by the hormones of the adrenal cortex. The effect is exerted through the tubular mechanism of the kidney. The separation of desoxycorticosterone from the other cortical hormones has shown that it is responsible for the control of electrolyte metabolism. This can now be studied independently of other effects, such as that on carbohydrate metabolism.

The volume is of the same high standard of production as the previous ones and is a valuable addition to a very useful series.

H. S. HALCRO WARDLAW.

Chemistry

ADVANCES IN CARBOHYDRATE CHEMISTRY. Volume IV. Edited by W. W. Pigman and M. L. Wolfrom. (New York: Academic Press, 1949. 378 + x pp., many text-figs. and tables). Price, $7.80.

This volume maintains the high standard of its predecessors in appearance and in wealth of information, and in its careful choice of the best contributors for each chapter. Within the

field of carbohydrate chemistry a wide variety of subjects is discussed. Significantly, the book begins and ends with sucrose, the commonest of all sugars, which so far has resisted all attempts to synthesize it by chemical methods. The first chapter is on 'The Structure and Configuration of Sucrose', by I. Levi and C. B. Purves; the last is on 'The Utilization of Sucrose', by L. F. Wiggins. Biochemists will find much to interest them in the chapters on 'Blood Group Polysaccharides', by H. G. Bray and M. Stacey, and on 'Biochemical Reductions at the Expense of Sugars', by C. Neuberg. Industrial chemists will find a wealth of information in the chapter on 'Wood Saccharification', by E. E. Harris. J. Böeseken contributes an excellent chapter on his favourite subject, the use of boric acid for the determination of configurations. Other chapters are on glycosides of parsley, nitriles of aldonic acids, hexitols, and plant gums and mucilages.

This is an excellent book, but it has one fault: it is not up to date. Most of the chapters were apparently written in or before 1946; indeed, one of the authors, R. M. Goepp, Jr., died in that year. It may be sound editorial policy in this type of publication to have the material in hand at an early date, but it seems imperative that the information be brought up to date before publication. This has been done in a few chapters by the inclusion of additional references, but in others the omissions are serious; for example, in the first chapter no mention is made of the X-ray investigation of sucrose by Beevers and Cochran (1946-7), a work which in itself provides as much evidence concerning the structure as all the other papers discussed in the chapter.

Only one error has been noted by the reviewer. On page 229 two melting points are given for 2:4-benzylidene-sorbitol, a substance which is not dimorph. The higher melting point belongs to the tri-benzylidene derivative.

The book is remarkably free of misprints. It is characteristic that the *Errata* for Volume III lists only one minor misprint. Author and subject indexes are most comprehensive. Anyone interested in the chemistry of carbohydrates will find this volume—like the previous ones—indispensable. It is only regrettable that not every branch of chemistry is covered by such a valuable series.

S. J. ANGYAL.

PRINCIPLES AND PRACTICE IN ORGANIC CHEMISTRY. By H. L. Lucas and D. Pressman. (New York: John Wiley; London: Chapman and Hall, 1949. 557 + xii pp., many text-figs. and tables, one folded chart. 5⅜″ × 9″.) Price, $6.00.

This book presents a year's course in practical organic chemistry. Although rather similar to several other well known texts in its general plan, it differs in one important respect. In the first chapter there is an elementary exposition of some fundamental physico-chemical principles, such as reaction rate and equilibrium, which are consistently and effectively applied to all topics dealt with throughout the remainder of the book. To aid in this and for general reference there are several very useful tables of physical data. The next eleven chapters are devoted to the purification of organic substances. The common laboratory techniques are clearly and thoroughly discussed with the aid of appropriate examples. A brief account of chromatography is also included towards the end of the book.

Apart from a short final chapter on qualitative analysis, the book deals with organic reactions. Starting with the alkanes, a chapter is allotted to each of the important classes of compounds, which are taken in the usual order. Each of these chapters has three parts. In the first part the common general methods of preparation of the particular class of compound are enumerated; then follows a brief but clear and adequate discussion of each of these from the preparative standpoint with emphasis on thermochemistry, equilibria, reaction rates and purification; lastly, directions for experiments are given, both of the preparation type and the properties type. These directions are profusely annotated, the notes being usually explanatory but sometimes indicating alternative procedures. Frequently general directions are given and the slight variations in procedure required for a particular substance are included in the notes. Approximately 130 preparations are described, mostly of the conventional type but of varying degrees of difficulty. It should be easy to select a good course from them. After each experiment a set of about a dozen questions appears. These are very searching; together with the notes they cover every point in the exercise. A curious feature of the book is the paucity of diagrams of apparatus; this occasionally necessitates a long and somewhat involved description. Some references to the original literature also might well have been included.

The volume is attractively printed, well bound, fully indexed, and altogether is a praiseworthy effort.

E. RITCHIE.

A CLASS BOOK OF PHYSICAL CHEMISTRY. By T. Martin Lowry and Samuel Sugden. (London: Macmillan, 1949. 454 pp., 73 text-figs., 93 tables. 4⅜″ × 7″.) English price, 8*s*. 6*d*.

This little book will continue to serve its purpose of providing an introduction to the physical chemistry which is largely confined to classical concepts, and deals in greater part with the properties of the liquid solution. The properties of the atom and its structure which the latter-day physical chemist finds so intriguing for the study of molecular behaviour, are systematically avoided, as also the general quantum theory; and there is scarcely a hint of the new ideas which have developed from the application of the quantum mechanics. Perhaps it is well that this should be the case,

because the young student has to assimilate new facts, and to learn to co-ordinate these facts, and to associate them with a number of classical laws which for statistical ensembles are never likely to be displaced.

The practical aspects of physical chemistry are very strongly emphasized: each chapter opens with a description of experiments which can be performed with simple apparatus, and which illustrate some of the principles discussed later on. This is an excellent feature, as is also the list of questions at the end of every chapter. Some aspects of the subject are developed more highly than others. The theory of activity and strong electrolytes is expanded considerably, although the Debye-Huckel-Onsager equations are not derived, but are used in the discussion of results. The subject of kinetics does not receive a very lengthy or very modern treatment. Occasionally errors enter; for instance, on page 291 the reaction between potassium iodide and potassium ferricyanide is described as quinquemolecular. This is misleading, as recent work showed it to be of not more than third order.

The section on thermodynamics does not appear to be very satisfactory. The ideas underlying this subject are always difficult for the elementary student to grasp, and they are not made any the easier by using abbreviated proofs, or by employing signs for heat and work change which have fallen into disuse in the standard works on the subject. To the chemist the system is more important than the surroundings: heat evolved is a loss and should be negative; work done by the system should also be negative. It is a little strange that the thermodynamic proof of the equilibrium state should be undertaken before the ideas associated with the existence of such states are developed in a subsequent chapter. We must assume that the teacher or student will arrange his reading in the correct order.

This book has the advantage of being a relatively inexpensive publication. It is of handy size, the print and diagrams are good, and the student who has read it carefully from cover to cover and has performed all the experiments will have equipped himself in no mean way for a study of the more advanced branches of the subject.

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Demography

Population Trends and Policies. A Study in Australian and World Demography. By W. D. Borrie. (Sydney: Australasian Publishing Co., 1948. 263 pp. 5½″ × 8½″.) Price, £1. 1*s*. net.

The success of this book is due to thorough and careful erudition, generally sound statistical method, an instructive comparative and historical approach, an extensive and informative bibliography, and a recognition of the limitations imposed upon the demographer by the realities of existing political, economic and cultural patterns.

Borrie aimed 'to study the implications for Australia of the revolutionary changes that have occurred and are occurring in the world of population, and to consider what alterations, if any, may be necessary to our economic and social organization if we are to establish a community capable of biological survival' (p. xviii). He succeeded admirably in achieving his first task; but as the second problem was the general task of the statesman, economist and social scientist he wisely went as far as but no farther than a demographer should, in suggesting a politically feasible and sociably desirable population policy, and posing for the economist the wider problems raised by this policy.

The argument is that a realistic policy must be developed within current concepts of democratic rights, that it must assume the family as the reproductive unit, and that it will depend upon international peace and a high level of economic activity. As it affects the birthrate, it must aim at population stability and not expansion, and must be fitted into a general social policy designed to create an environment favourable to this aim. Bribes and penalties will not succeed. If a greatly expanded population is desired it must, in the short term, depend upon migration from areas of high fertility which are no longer Australia's traditional sources of supply.

The arrangement of the book is as follows.

Part I (two chapters): Analyses eastern and western population trends, to underline the urgency of a population policy for Australia and the importance of the demographic revolution in the traditional sources of migrant supply.

Part II (seven chapters): Studies demographic trends in Australia. 'The historical evolution of fertility patterns is typical of the western world . . . The significant feature . . . being the decrease in the size of the completed family and the negative correlation between such factors as city size, occupational status and income, and the size of the family' (p. 246).

Part III (two chapters): Analyses the economic and social consequences of fertility decline, in order to show the necessity for pronatalist policy.

Part IV (two chapters): A comparative and historical analysis of the aims and techniques of pro-natalist policies adopted by France, Germany, the Soviet Union, Italy and Sweden; followed by an outline of 'the principles of a pro-natalist policy which would be politically and socially feasible in Australia, with the object of relating such policy to recent and current social service developments' (p. xix).

Part V (one chapter): Anticipates the criticisms of the population expansionist 'by considering the international implications of the central theme, that rapid population expansion through high fertility is no longer feasible

for Australia' (p. xix). This is amplified in Borrie's later work, *Immigration*, 1949, R.I.I.A.

It is possible to dispute side issues; for example, to argue that dependence upon fertility rates to indicate sources of supply of migrants overlooks the political factor—that is, a readiness to migrate, because of international and economic insecurity, from countries with declining fertility rates. But the main arguments and conclusions are unchallengeable. If it is held that there is little that is new, it must also be admitted that no other work performs so admirably the function for which this book was designed.

R. G. NEALE.

Electronics

ADVANCES IN ELECTRONICS. Volume I. Edited by G. L. Marton. (New York: Academic Press, 1948. 475 pp., 126 text-figs. 6″ × 9″.) Price, $9.00.

This book is the first of a series, to be published yearly. It is intended that the yearly publications will be devoted to critical and integrated reviews of specific topics in the field of physical electronics and in selected fields of engineering electronics. The term 'physical electronics' is used here to mean the basic physics of charged particles (both positive and negative)—emission phenomena, shaping and guiding of beams, space charge effects, interaction with matter, etc. Engineering electronics embraces the methods and instrumentation for practical application of such charged particles in the numerous devices which use them. Ten monographs make up this volume.

In 'Oxide Coated Cathodes', by Albert S. Eisenstein (65 pp.), a research worker well qualified in this field discusses the theoretical aspects of the subject very competently from the standpoint of the modern theory of semiconductors. Sections are included on the properties of the coating, the interface, the complete cathode, and thin oxide film phenomena. 'Secondary Electron Emission', by Kenneth G. McKay (65 pp.), covers the secondary emission of pure metals, insulators, and composite surfaces. The large number of experimental results and articles reviewed make this section a complete self-contained review of the subject. This is particularly useful, as much of the information on this subject is published in languages other than English. 'Television Pickup Tubes and the Problem of Vision', by A. Rose (36 pp.), treats in a general manner the limitations imposed on optical devices by the finite number of available light quanta. This is a fundamental limitation common to the eye, to pickup tubes, and to photographic films. Emphasis throughout is on the setting up of an absolute scale of performance according to which many and diverse pickup devices can be oriented.

R. G. E. Hutter discusses the theory of deflection for both small and large angles quantitatively in 'The Deflection of Beams of Charged Particles' (52 pp.). Defocusing effects of deflexion fields are described. 'Modern Mass Spectroscopy', by Mark G. Inghram (50 pp.), covers the various basic designs of mass spectrograph and applications in research and engineering. 'Particle Accelerators', by M. Starkey Livingston (48 pp.), explains in detail the principles of particle accelerators and the various factors which determine the construction and particle energy. A. G. McNish in 'Ionospheric Research' (30 pp.) gives a descriptive summary of ionospheric research results obtained since World War II. Early work on 'Cosmic Radio Noise' is reviewed by J. M. Herbstreit (34 pp.). K. A. Norton discusses, in 'Propagation in the F.M. Broadcast Band' (44 pp.), the effect of antenna height, terrain, reflection, and interference. 'Electronic Aids to Navigation', by J. A. Pierce, covers general aspects of the subject.

Some of the papers are the only recently published general surveys of the subjects commonly available. With extensive and up-to-date references, the papers meet the high standard expected in series of this type, and make the volume a valuable reference text for research workers. With ten contributors, each writing on ten different topics, it is not surprising that a uniform standard is not maintained throughout the volume, as regards both content and presentation.

R. E. AITCHISON.

Food Science

CANNING PRACTICE AND CONTROL. Third Edition. By Osman Jones. (London: Chapman and Hall, 1949. 322 + xvi pp., 121 text-figs. and photos.) English price, £1. 6*s*.

The literature of canning technology is predominantly American, and until very recently 'Jones and Jones' was the only text in this field published in England. (There is a comment in the Introduction: 'Any sensible person would swop all Bikini Atoll for one steamed marmalade pudding', that could have been written nowhere else but in England.) The book appears now in a third edition under the single authorship of Osman Jones, F.R.I.C.; the former co-author, T. W. Jones, has withdrawn because of other interests. Some additions have been made in the new edition, notably a chapter on the manufacture of tinplate and cans; but it is difficult to discover any references to the literature later than 1939.

The book follows its title, *Canning Practice and Control*, in strictly literal fashion. In seven general chapters commercial practice in canning and glass-packing is described, but little attempt is made to present the theoretical background to canning technology. The remaining ten chapters constitute a compendium of methods of laboratory control, covering the chemical and bacteriological examination of water, the raw materials for canning, and canned foods. The usefulness of this type of

compendium is very doubtful. Canning chemists and bacteriologists will find the general chapters too shallow in treatment to be stimulating, and they would be wise to refer directly to specialist sources for the details of analytical procedures, particularly on such subjects as the chemical and microbiological assay of vitamins. There is very little critical discussion of methods of analysis and, as already noted, there is a lack of appreciation of recent developments. The isolation, staining, and cultural characteristics of food spoilage organisms are discussed very fully and illustrated in a series of spectacular microphotographs; but the emphasis that is given to this aspect of the subject is perhaps misleading, since it is very seldom necessary for the investigator of spoilage in canned foods to identify precisely the organism responsible. In most cases identification as a sporing or non-sporing organism is sufficient for the purpose of diagnosing the cause of spoilage.

Perhaps the most useful features of the book are the photographs, particularly those illustrating British food machinery. The Australian canning industry, hitherto strongly biased towards American techniques and equipment, may find it profitable, in view of dollar shortages, to investigate the range of cannery plant available in Great Britain.

J. T. Kefford.

Geophysics

Seismicity of the Earth. By B. Gutenberg and C. F. Richter. (Princeton: University Press, 1949. 277 pp., 34 maps. 7¾″ × 10¾″.) Price, $10.00.

This work of two of the world's most outstanding seismologists will be of value to advanced students in many fields of geophysics and geology.

The first 104 pages present, in beautifully set out form, an account of the relative seismicity of various parts of the Earth since 1904, when precise seismic data started to become available. Geographical and geological relations of the principal earthquake zones and areas are discussed, including correlation with mountain structures, oceanic deeps, gravity anomalies and active volcanoes. A new check-list of active volcanoes is included. The origin of earthquakes is discussed, particularly with reference to folding and thrusting in the structural arcs of Pacific type. There are thirteen pages of detailed references. These are followed by 154 pages of tables giving the locations of earthquakes in geographical order and grouped according to depth, together with carefully assembled chronological lists of the larger earthquakes during the period studied.

The reviewer is in a position to know of the very great work which lies behind the production of this book. It has involved the reading of innumerable seismograms and the performing of vast quantities of computation; the book incorporates work that the authors have carried out over a period of the order of twenty years. The material is so well presented and so well illustrated with diagrams that the reader who is not a specialist in seismology would hardly appreciate the magnitude of the task that has been carried out. An authoritative work such as this one will be a stimulus to research in all related domains. The book is readable and beautifully produced.

K. E. Bullen.

Laboratory Technique

Glass-to-Metal Seals. By J. H. Partridge. (Sheffield: The Society of Glass Technology, 1949. 238 pp., 166 text-figs., 39 tables. 5½″ × 8½″.) English price, £1. 15*s*.

The methods of making vacuum-tight seals between glasses and metals which are in use today have a variety and interest that are in sharp contrast to the state of the art a short forty years ago, when practically the only sealing metal used was platinum. This rapid development of seal-making materials and methods has taken place mainly in response to the ever-increasing demands of industry and scientific research. Methods are now available for sealing quite a large number of glasses to metals and specially developed alloys, the glasses ranging from the 'soft' varieties with expansion coefficients in the region of 9 to 10×10^{-6} per degree C., through Pyrex ($3{\cdot}2 \times 10^{-6}$), to fused silica ($0{\cdot}5 \times 10^{-6}$).

While most seals, like the original one with platinum, depend on at least an approximate match between the thermal expansions of the two components, there are important exceptions, as in the case of copper-glass seals, and molybdenum ribbon seals through silica. Here the accommodation between glass and metal takes place mainly by plastic flow of the latter at low stress, and the seals have to be specially shaped to avoid the setting up of dangerous stresses in the glass. In the book under review all these different kinds of seals are discussed in detail, in all their variety of materials used, shapes, sizes, and techniques employed. The author is peculiarly fitted for this task, having been for many years in charge of a section of the Research Laboratories of the British General Electric Company concerned with glass problems.

Many related and incidental topics are also discussed in this very comprehensive monograph, such as the joining of one kind of metal to another; the making of graded seals between different kinds of glass, e.g., between soft lead glass and Pyrex, and between Pyrex and silica; indirect methods of joining glass to metal, such as that depending on platinization of the glass and the use of solder; glass-to-ceramic and ceramic-to-metal seals; and the photo-elastic examination of seals for stresses. Due attention is given throughout to physical and chemical factors, such as oxidation of the metal and the adhesion of the oxide to both

the underlying metal and the glass, the distribution and magnitude of stresses as a function of geometrical form, etc.

The arrangement of the book is such that it is not always easy to find the whole of the information sought on any particular topic—it may be distributed among a number of chapters. This difficulty is aggravated by the fact that the index is not as complete or as systematic as one could wish. These are relatively minor blemishes, however, in what is otherwise a very well written and well produced book. In addition to line drawings, it contains a large number of photographs of excellent quality.

A. L. REIMANN.

Mathematics

HIGHER ALGEBRA FOR THE UNDERGRADUATE. By Marie J. Weiss. (New York: John Wiley; London: Chapman and Hall, 1949. 165 pp. 5½" × 8½".) Price, $3.75.

Not more than ten or fifteen years ago, higher algebra was widely considered as a branch of mathematics to be studied only by specialists, so that in many universities the average student of mathematics had no opportunity of learning this subject in lectures. The lecturer who wished to deal with the matter found it difficult to refer to a suitable book for the non-specialist. Due to the increasing demand for higher algebra in physical and engineering sciences, statistics, and elsewhere, as well as with regard to the advanced systematization within mathematics itself, conditions have changed since. Many text-books on higher algebra are available now, mostly by American authors. Nevertheless the present book by a former student of the late Emmy Noether will prove to be very useful for students of mathematics and the sciences, because of its really elementary approach to the matter. Honours students will have no difficulty with the book at the beginning of their second year, or even earlier; others will certainly profit by it at the beginning of their third year or earlier. The reader who has worked through this book will be well prepared to proceed to one of the advanced texts.

The content of the book coincides in many details with the more elementary parts of lecture courses which the reviewer has had the opportunity to give at the University of Adelaide and the University of Melbourne since 1940. It has eight chapters. I. The Integers; divisibility, prime numbers, congruences, remainder classes, all in a very simple fashion. II. Rational, Real, and Complex Numbers; no rigorous introduction of the real numbers, but a clear description of the facts essential for algebra. III. Elementary Group Theory; including permutations, up to Cayley's representation. IV. Rings, Integral Domains, Fields. V. Polynomials over a Field; factorization, irreducibility, but no criteria, roots, fundamental theorem without proof. VI. Matrices over a Field; addition, multiplication, linear independence, inverse, equivalence, linear equations. VII. Determinants and Matrices; multiplication theorem, Laplace expansion, matrix polynomials and a neat proof of Cayley-Hamilton's identity. VIII. Groups, Rings, Ideals; quotient group, automorphism, homomorphism with simple applications in the theory of commutative rings.

The book concludes with a bibliography of twenty-eight items — English, French and German books on algebra and related matters. The inexperienced reader will miss some guidance as to their nature since in the list there appear books of most elementary character (e.g., Albert's *College Algebra*) together with highly specialized and advanced treatises of monograph type, as for instance Pontrjagin's *Topological Groups* and Hecke's *Algebraische Zahlen*, for which the reader of Professor Weiss's book will hardly be prepared. On the other hand, some recommendable texts are not mentioned, e.g., Ferrar's and Levi's.

The book is written in an extremely clear style and will be appreciated by students and teachers. Numerical examples are given frequently in order to illustrate all important definitions and results. Each section is followed by a set of exercises, all of very simple type. The printing is carried out according to the best standards of presentation of mathematics.

H. SCHWERDTFEGER.

Physics

A GENERAL KINETIC THEORY OF LIQUIDS. By M. Born and H. S. Green. (Cambridge: University Press, 1949. 98 pp. 6¾" × 10¼".) English price, 10*s*. 6*d*. net.

This volume was not originally written in book form, for it is a photolithographic reproduction of six papers which have appeared in the *Proceedings* of the Royal Society of London during the past two years. The authors state that the demand for reprints of these papers was so great that their stock was exhausted and they therefore published the material in book form. This material consists of general statistical theory applied to liquids, and is of course largely mathematical. The actual applications of the theory to various physical properties of liquids and to the problem of melting have been begun by some of the authors' pupils, but have not yet been published. The volume will therefore be of interest largely to specialists. Yet the work is a contribution of considerable importance to fundamental work on the liquid state, which is far less well-understood than the gaseous or the solid state.

No very useful purpose will be served here in attempting to convey the detail of the work, though readers of this review may gain an idea of the ground covered from the titles of the six chapters: I, The molecular distribution

functions; II, Equilibrium properties; III, Dynamical properties; IV, Quantum mechanics of fluids; V, The kinetic basis of thermodynamics; VI, Liquid He-II. The six chapters appeared as papers in Vols. *188*, *189*, *190*, *191*, *192* and *194* respectively of the *Proc. Roy. Soc.*, A.

The last chapter is the most interesting, in as far as it contains the first application of the general theory of the previous chapters; an application of particular interest in view of the remarkable properties of superfluidity, etc., of liquid helium, which have attracted general attention in recent years. Previous theories of He-II have assumed the existence of two different phases in the liquid, only one of them being supposed to take part in the superfluidity; and these theories have appeared to be further justified by their prediction of two different, but simultaneous, velocities of 'sound' in the liquid. The assumption of two distinct phases is not required in the present theory, which accounts for the properties of He-II in terms of the general quantum statistical theory; and the 'second sound' is attributed to the propagation of thermal waves, whose existence was demonstrated experimentally a few years ago. The theory seems to be very powerful and general in form, for it is stated that it 'can easily be applied to the electrons in a metal and the phenomenon of superconductivity', a phenomenon which is still not generally considered to be accounted for in an entirely satisfactory manner. Those wishing to study this work in detail will find it convenient to have the papers thus collected together and suitably bound in book form.

C. B. O. Mohr.

Cosmic Radiation. Colston Papers.* (London: Butterworth, 1949. 189 pp., numerous text-figs. 7½″ × 10″.) Price, £1. 14*s*.

The present volume is the first of a series intended as reports of symposia which are promoted by the Colston Research Society and the University of Bristol.

The first of these symposia on cosmic rays taking place at Bristol would be expected to have been largely devoted to the photographic plate technique which has been brought to its present efficiency mainly by Powell in Bristol. In fact in about one-third of the papers the photographic emulsion technique has been applied. The discovery of the π-meson, the particle of the nuclear forces, and also the co-discovery of particles heavier than protons in primary cosmic rays, are the greatest achievements of this technique. Besides the state of this research at the end of 1948 in the sections on 'Experiments on the Primary Radiation' and 'Experiments on Mesons of Mass 300', other papers report further results obtained by this technique in the investigation of nuclear explosions. This section, 'Explosive Disintegration of Nuclei by Cosmic Radiation' also contains a paper on slow neutron intensity in the atmosphere. Rossi's survey of disintegration and nuclear absorption of mesons introduces the section on 'Experiments on Cosmic Ray Mesons of Mass 200'. The question of the decay products of μ-mesons which had to be left open in this paper has in the meantime been decided by new experimental results in favour of one electron and two neutrinos.

The section on 'Penetrating and Extensive Air Showers' is not fully representative of the great interest and the amount of work done on this subject at the present time. The few papers presented, however, show clearly the difficulties of experiment and interpretation encountered in this branch of cosmic ray research.

In the section on 'The Present State of Meson Theory' the papers which do not have recourse to mathematics give a clear exposition of the difficulties of a theory of the meson forces. Despite the fact that experimental knowledge is ahead of theory, the theoreticians need more experimental results to decide which, if any, of the several theories developed in mathematical formalism may give an interpretation of observation. The discovery of the meson forces which adds a new force field to the known gravitational and electromagnetic fields may in the end make it necessary to modify the basic concepts of theoretical physics.

Workmanlike plans mixed to fantastic projects are grouped under 'Technical Subjects'.

On the whole the book, which is well made, gives a good survey of the parts of cosmic ray research under most active growth at the present time.

The reviewer only regrets that scientists who were not so fortunate as to attend the Bristol Symposium had to wait more than a year for its publication and that even at the present time it is difficult to obtain a copy here.

H. D. Rathgeber.

* Based on the first of a series of symposia promoted by the Colston Research Society and the University of Bristol in September, 1948; published as a Special Supplement to *Research*.

Elements of Thermodynamics and Heat Transfer. By E. F. Obert. (New York: McGraw-Hill, 1949. 372 pp., 137 text-figs., 12 tables, 7 folding charts. 6″ × 9″.) Price, $4.50.

This new book is a condensation of the author's *Thermodynamics*. It consists of fifteen chapters, of which the last is on Heat Transfer. The rest of the book, as the name implies, is on thermodynamics, and includes the fundamentals as required for the theory of heat engines. There is very little of a descriptive nature in regard to engines, turbines or other apparatus. The ground covered includes those matters usually dealt with in books of such character, all in a very thorough manner. The style is clear and the author is particularly careful in regard to detail; for example, the pound unit is denoted as lb_m or lb_f according as it refers to mass or force. And weight is

expressed as mg/g_c, where m is the mass in pounds, g is the local acceleration of gravity, and g_c is the numerical value of the standard gravitational acceleration.

The chapter on heat transfer forms a good introduction to the subject. Each chapter contains a few worked examples, and concludes with a number of others, but the answers of the latter are not given. The book is well printed and the figures are clear. One of the tables in the Appendix is concerned with the properties of mercury vapour. Altogether this is a book which can be recommended as a useful addition to the library of anyone interested in thermodynamics or heat engine theory.

E. J. C. Rennie.

Wool Research

Wool Research 1918-1948. Volume 4, Carding; Volume 6, Drawing and Spinning. (Leeds, England: Wool Industries Research Association. Volume 4: 224 pp., 153 text-figs., 86 tables. Volume 6: 225 pp., 119 text-figs., 95 tables. Each 9¾" × 7".) English price, £1. 1s. each.

These volumes are the first two to be published of a series which is to include eleven altogether, and which will gather together thirty years' work by the Wool Industries Research Association. Much of the material has not previously been published excepting in the W.I.R.A.'s Bulletin and Technical Papers, which have a restricted circulation. The series is intended to be useful to research workers, technicians, teachers, and members of industry.

Both volumes are excellent productions, exceptionally clearly written and very well illustrated. While they make no attempt at a broad survey of work done in other laboratories, the work done in the Association's own laboratories undoubtedly constitutes a large part of the total, so that the volumes are a valuable addition to wool textile literature. Indeed, they seem likely to be appreciated by all the varied types of people for whom they were intended.

The present two volumes are too technical to warrant a full review in This Journal, but a few comments may be made here. Volume 4, 'Carding' contains the clearest description yet seen by the reviewer of events occurring during carding (the process of spreading out the entangled wool fibres into a thin web prior to spinning), and this description is convincingly illustrated by photographs taken on an experimental carding machine. Both volumes are almost entirely free from typographical and other errors. In view, however, of the wide audience for whom the volumes are intended, a glossary of technical terms would have been a desirable addition.

K. R. Makinson.

The Australian Journal of Science

Vol. 12 21 April 1950 No. 5

The Zoogeography of the Diptera*

I. M. MACKERRAS†

THE origin and composition of the Australian fauna is a time-worn subject. It is an unsatisfactory one, too, because it is so difficult to test the hypotheses that may be built on distributional and morphological evidence. Nevertheless—perhaps, indeed for this reason—those who touch on it become addicts, and cannot leave it alone. That is the excuse for this paper; and its purpose is to emphasize two sets of facts, which are often neglected in discussions: firstly, the regularity with which precisely parallel data can be obtained from widely different groups of animals; secondly, the reality of certain faunal provinces within Australia. No hypothesis is adequate, unless it includes an explanation of both of these phenomena.

It is salutory to remember that the biogeographical provinces were clearly established more than fifty years ago. The foundation was laid by Tate at the first meeting of the Australasian Association for the Advancement of Science in 1888; Hedley subdivided the eastern section at the fifth meeting in 1893; and Baldwin Spencer re-defined and re-named the provinces in 1896, although he eliminated Tate's Autochthonian province as not recognizable in the higher animals.

The same workers also recognized the main faunal elements. Tate wrote of 'Andean' and 'Oriental' elements, and Hedley made them the basis of his eastern subdivisions. Spencer accepted them, too, and believed that there were three northern invasions as well as a southern.

Subsequent writers tended to make and break land-bridges more or less at will to suit the particular distributional problem before them at the moment; Tillyard (1924), for example, listed no less than ten faunal elements in the insects. Geologists, however, grew captious at this cavalier treatment of the Earth's crust; so biologists had to become more cautious. Thus, Harrison (1928) accepted an ancient autochthonous element (doubtful in animals); a rather prolonged southern invasion ending about the Miocene; and two northern invasions, the first (Lemurian) in the Pliocene and the second (Indo-Malayan) in the Pleistocene. Others have gone further, and endeavoured to bring all animals into Australia through a series of Asiatic connexions. To either we may add recent introductions, for introduced insects now form quite a conspicuous element in our fauna.

In considering the Diptera in relation to these problems, it is necessary to remember that they evolved as a separate Order in the Permian, possibly in southern lands (Tillyard, 1935); that the Nematocera and Brachycera were well developed by the end of the Mesozoic; but that most of the Cyclorrhapha apparently formed part of a middle and later Tertiary radiation, for they were poorly represented in early Tertiary fossils (Sharp, 1901, p. 458).

It will be convenient to use Harrison's elements and Spencer's (1896) names for the provinces as a framework for the present discussion.

1. *Autochthonous*

An autochthonous fauna, in the sense of an ancient community restricted to south-western Australia, cannot be recognized in the Diptera. South-western Australia has its characteristic group of species, for example in unusual Tabanidae, Nemestrinidae and Bombyliidae, but they are clearly derivable from faunal elements occurring elsewhere in the continent, especially from the Bassian element. The term may, nevertheless, be used in two other senses.

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* An address delivered to the Entomological Society of Queensland.

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First, it may be used for the relics of an ancient fauna, now found in only a few parts of the world, and of quite undeterminable origin so far as Australian representatives are concerned. Two groups of primitive Nematocera fulfil these conditions (Alexander, 1926, 1928). The Trichoceridae occur in Tasmania, New Zealand, Sub-Antarctic Islands, the high mountains of the Oriental Region, Formosa, and scattered parts of Holarctica from Japan to the western United States. The Bruchomyiinae (Psychodidae) have been found in New South Wales (Dorrigo), New Zealand, Canary Islands, Paraguay, Argentine and Baltic amber. If Wegener be right, these groups may have been distributed before the continents separated widely. It is an interesting anomaly that the equally primitive Tanyderidae show all the stigmata of an 'Antarctic' radiation.

The second sense in which we may use the term is for groups with no known relatives. We will only instance the Nemestrinid genus *Exeretoneura*. It is restricted to Australia, has many primitive features, cannot be related with confidence to other members of the family, and so we cannot even surmise where its ancestors came from. To call such genera autochthonous is a cloak for ignorance. That does not matter, so long as we realize it; and it is less indefensible than setting aside whole lists of genera as 'endemic', when we know perfectly well the stock from which they were derived.

2. *Bassian*

This is the element which the writer has previously called 'Antarctic'; but the older, non-commital name is used here in order to emphasize that it is a definite element in the fauna, however arguable may be the path by which it entered the country. He would point out, as Baldwin Spencer (1896, p. 186) did long ago, that one cannot reasonably argue about its origins from groups which do not belong to it. Hardy (1944) has done so with the genus *Sarcophaga*, and he is not alone, for many zoologists have endeavoured to apply Mathew's quite reasonable conclusions about Eutherian mammals to other groups which evolved at different periods in the earth's history.

The characteristics of this element in the Diptera are:

(1) Its members are relatively primitive: many lower Nematocera, many lower Brachycera, few Cyclorrhapha. This holds also within families; genera which have retained annectant stigmata frequently belonging to this element, whereas more specialized genera belong to other elements.

(2) All are found in Australia and southern South America (Patagonia, Chile), and some also in New Zealand. Some extend along the Andean chains and are widely distributed in Holarctica. They are not represented in the Oriental Region and rarely in the Ethiopian. These wider distributions do not matter—they can be used with equal ingenuity in argument by either side —the essential characteristic of the group is the Australian-South American relationship.

(3) In Australia, they occur predominantly in the south (Tasmania to southern New South Wales), with a tongue extending up the Dividing Range, and varying degrees of overflow further afield, as will be indicated later. They occupy, in fact, the Bassian province, which, however, they share with a few ancient autochthones and a sprinkling of later invaders.

(4) In the south and in high country the adults are on the wing in summer; on the coast further north they are restricted to the spring. At Sydney, for example, Diptera collected in the spring are predominantly Bassian, in summer predominantly Indo-Malayan.

The genus *Pelecorhynchus* is a perfect example of this faunal element, having all the stigmata listed above. Its evolution as a group has clearly been slow, although recent speciation within the group (which is not the same thing) has been quite vigorous. I believe that the weight of evidence points to the entry of this Bassian element into Australia from the south (Mackerras and Fuller, 1948), but the arguments need not be recapitulated here, because we are concerned only to define its reality as a distinct element with well-defined facies, distribution and affinities.

3. *Lemurian*

Harrison adduced zoogeographical evidence that some animals entered Australia from the north during the Pliocene. They spread like the later Indo-Malayan element, but may be recognized by their restricted extra-limital distributions. There appear to be a few examples of this 'Lemurian' element in the Diptera. Thus, the writer has previously (1927) suggested that Group B of the mosquito subgenus *Ochlerotatus*—which occurs in the Neotropical Region, in islands to the north of Australia, in the north-eastern part of the continent, and in New Zealand—may belong to it. A few Tipulid genera and the Bombyliid genus *Lomatia* are other possible instances, as may be some of the Cyclorrhapha.

4. *Indo-Malayan*

This element is as well defined as the Bassian, and is even more abundant. It includes a great assemblage of relatively recent, successful insects, which entered Australia from the north during the Pleistocene, dominate the Torresian province, and overflow quite widely beyond its limits. In the southern part of their range, adults are found to be active particularly during the hot months. Anopheline mosquitoes, the Tabanid genus *Silvius*, the Calliphorid genus *Chrysomyia* and a host of others could be quoted as examples. The element is so well recognized, and its path of entry into Australia so generally accepted, that one need say no more about it.

5. *The Eyrean Province*

We cannot speak of the occupants of this area as an element, because, as Tate pointed out, its fauna is constituted by an adaptable minority from the elements already considered. Two examples may be given, one northern and one southern. *Musca vetustissima* Walk. belongs to a group of flies which is widespread in the hotter, drier parts of the world; it is, in fact, difficult to distinguish in appearance and behaviour from *M. sorbens* Wied. which plagued the troops in the Western Desert. It was not an introduction, for it is recorded that it met Dampier in swarms when he first landed on our continent. It is the dominant insect of the dry interior, and its ecology is still a mystery.

The second example is *Austrosimulium pestilens* M. and M. Derived from southern ancestors which lived in cool, rippling mountain brooks, it has become adapted, not only to thrive in the turbulent, muddy waters of flooding western streams, but to lie up in some drought-resistant stage, sometimes for years, until flood waters come down again and permit it to complete its cycle. Desert animals are widely known for their striking adaptations, and the Diptera are not the poorest of them.

6. *Some Individual Examples*

It is a striking fact that, whatever group of lower Diptera one studies, one finds examples of the southern and northern elements clearly distinguishable from one another. The lowest Nematocera and Brachycera are either indeterminate (Trichoceridae, Bruchomyiinae) or southern (Tanyderidae, Chiromyzini, Pelecorhynchidae); but the next step up in evolution, so to speak—those which have become somewhat more specialized and have undergone a reasonably wide adaptive radiation—show the characteristics mentioned. Thus, in the mosquito genus *Aëdes*, the subgenus *Finlaya* (amongst others) is northern, one section of *Ochlerotatus* is southern, and the other section possibly Lemurian. In the Tabanidae, *Scaptia* is southern and *Silvius* northern; while within the single genus *Tabanus*, the hairy-eyed species (broadly) are southern, the bare-eyed are northern. In the Nemestrinidae, *Trichophthalma* is southern, *Atriadops* and allies northern, *Cyclopsidea* appears to be derived from the northern stem, and *Exeretoneura* remains 'autochthonous'. In the Bombyliidae, *Comptosia* is southern, *Exoprosopa* cosmopolitan but clearly part of the Indo-Malayan element so far as Australia is concerned.

Our recent studies of the Simuliidae have given similar results, and these insects have the particular value that their habitat is restricted, and the characters of the adults are corroborated by those of the larvae and pupae. The genus *Cnephia* is widely distributed in the Holarctic Region, has one Ethiopian species, and none in the Oriental Region: it is well developed in Chile and Patagonia, and is represented by two distinct groups of species in Australia. One, the *aurantiacum* group, is closely related to certain Patagonian species; so closely that Edwards (1931) compared the Patagonian *C. dissimile* Edw. with the Australian *C. aurantiacum* Tonn. as its nearest

ally. This group is typically Bassian in distribution, being found in Tasmania, Victoria, Mt. Kosciusko, the Australian Capital Territory, and the Blue Mountains in New South Wales, with one extension into Western Australia and another into south Queensland at and below Springbrook (2000 feet) and on Stradbroke Island. Most remarkable, there is a far outlier in a hill stream behind Cairns.

The other (*terebrans*) group occurs in Victoria, South Australia, Western Australia, and the southern half of New South Wales west of the Divide. We can say no more about it, not because it is odd, but because we do not know enough. When the early stages are discovered, it should be possible to place it with precision. This is an example of an 'endemic' or 'autochthonous' group, which may be so only because of ignorance.

The genus *Austrosimulium* is also southern, with two species in Chile, seven in New Zealand, and twelve in Australia. It shows the same Bassian distribution, with five species in Tasmania, five in Victoria, and six in New South Wales and the Australian Capital Territory. It has, however, undergone a wider adaptive radiation, like the genus *Trichophthalma* of the Nemestrinidae, and has one species in South Australia, three in Western Australia, and six in Queensland, of which one extends as far north as Babinda and another (*A. pestilens*) at least as far west as Windorah; *A. bancrofti* Tayl. occupies an intermediate type of environment in the Burnett and Dawson Valleys.

The genus *Simulium* stands in sharp contrast with those reviewed above. It is worldwide in distribution, but has been subdivided into various groups and subgroups of species in different regions. The genus as a whole is distributed in Australasia as follows: New Guinea four species, Northern Territory three,* Queensland eight, New South Wales two, South Australia one, Western Australia one; none has been recorded from Victoria, Tasmania, or New Zealand, although Tonnoir examined these areas very thoroughly. Three groups are represented in Australia. *S. ornatipes* Sk. represents Edwards's (1934) subgroup D from Java and Sumatra, and is widely distributed from New Guinea to Perth, but apparently misses Victoria. His subgroup C, also from the Sunda chain of islands, is represented by one undescribed species from Cape York, and probably another from the Northern Territory; one of the imperfectly known New Guinea species may belong here also. The third (*clathrinum*) group is restricted to New Guinea, the Northern Territory, Queensland (six species), and New South Wales (one species, with a range from Cairns to the Blue Mountains). The group is distinctive, but clearly shares a common ancestry with the subgroup C noted above.

Thus the genus *Simulium*, in each of the three lines of evolution represented in the region, is unequivocally Torresian in distribution and Indo-Malayan in origin.

It is difficult to visualize how such differences in local distribution and affinities could be so clearly defined, if the different elements all entered Australia by the same route, even though at different periods in its geological history. This is the crucial difficulty in the thesis that Australia was populated from northern migrations only, and the writer has not seen the protagonists of that thesis make a serious attempt to meet it.

7. *Introduced Species*

No account of the faunal elements in Australian Diptera would be complete today without some mention of the introduced species. They are numerous in individuals, force themselves on the attention of man, and declare themselves by their origins, their associates, and their distribution. A few examples only may be given.

In the mosquitoes, *Culex fatigans* Wied. may well have arrived with the First Fleet. It is now widely distributed wherever there are human settlements, except, perhaps, at the southern end of the continent where it may be replaced by a race of *C. pipiens* L. It is interesting that filariasis appears also to occur on the mainland of Australia only where civilization has intruded, and to be absent from native communities which have relatively little contact with whites; so the worm, like its vector, was probably introduced.

Siphona exigua de Meij. was a somewhat later arrival from the north. It spread slowly through the Northern Territory, hesitated for some years before the barrier presented by

* The islands to the north of Australia and the Northern Territory have not been searched intensively for Simuliidae.

Cape York Peninsula,* but finally broke through, and swept down the coast of Queensland during the recent war. Its distribution inland is limited by the 20-inch rainfall line, and its southern limit is not yet fixed. Handschin (1932), from a study of the effect of temperature on the growth rate of the larvae, concluded that its effective limit would be not far south of Rockhampton; others of us thought that it might reach the northern rivers of New South Wales. At the moment, Handschin appears to be more nearly correct.

Lucilia cuprina Wied. is as closely associated with sheep as *S. exigua* is with cattle, and is of considerably greater economic importance. There are many additional economic Diptera, and a considerable number of others which are of no importance and therefore not noticed. The large Stratiomyiid, *Hermetia illucens* Latr., is an example of these. It is quite common in Brisbane, but the writer does not think that anyone knows where it came from. The traffic is not all one way, for an Australian Stratiomyiid, *Metoponia rubriceps* Macq., has recently appeared in California (Kessel, 1948), and it will doubtless increase as methods of transport continue to improve.

Conclusion

This review makes no pretence to be exhaustive, nor does it offer any new solution to the problems of distribution. It does, however, attempt to show that the Diptera present the same series of problems as have been studied in larger groups, that the same sets of distributional phenomena are repeated again and again throughout the Order, and that the biogeographical provinces of Tate, Hedley and Spencer are as sound for the Diptera as for the groups on which they founded them.

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* Probably retarded also by human efforts to delay it.

International Laboratories—II*

The Hylean Amazon

The International Institute of the Hylean Amazon was created in May 1948 by a conference (called jointly by Brazil, Peru and UNESCO) which was held in Iquitos, Peru. The Final Act of the Conference was signed outright by France, and *ad referendum* by Bolivia, Brazil, Colombia, Ecuador, Holland, Italy, Peru and Venezuela. Observers from U.S.A. and the United Kingdom also stated that they would study ways of bringing about active participation by their countries. The seat of the Institute was established at Manaus, Brazil, and it was agreed that centres of study should be established at Belem (Brazil), Iquitos (Peru), San Fernando de Atabapo (Venezuela), Riberalta (Bolivia), Archidona (Ecuador) and Sibundoy (Colombia); the work of the Institute being carried out over the Amazon field itself.

The term 'Hylean' is derived from the Greek ὕλη, wood: it refers to a region of about four and a quarter million square miles, mostly of dense tropical forest, with a population of about 200000 which lives on the banks of the rivers. Large portions of the region are quite unexplored, and such explorations as have

* Continued from This JOURNAL, *12*, 125.

taken place have not been preserved, co-ordinated or followed up by a central body. Possible projects of the Institute were suggested as:

(a) pedology and physical geography;
(b) overall botanical exploration;
(c) census of fauna, with reference collections;
(d) termites and ants (study and control);
(e) rational development of forestry;
(f) survey of structure of type rural communities;
(g) mobile teams with modern equipment in fundamental education (study of possibilities);
(h) study of population decline;
(i) folk-lore, arts and crafts, language.

In addition to the services of its Latin America Field Science Co-operation Office (This JOURNAL, *11*, 43, 1948), UNESCO made provision for expenditure from its funds of $55000 during 1948, on the understanding that it would have no financial commitment beyond 1948. The initiating conference proposed a budget of $300 000 for the first year of the Institute, assessing Brazil $150 000, Colombia and Peru $40000 each, Venezuela $25000, France $15000, Bolivia $9000, Ecuador and Holland $5000 each. Following the conference, an Interim Commission met at Manaus, delimited the area, set up a secretariat and defined its duties. Member nations were to take over the finance of the secretariat from UNESCO in 1949.*

It is now understood that only France and Ecuador have as yet ratified the Final Act of the establishing conference. As at least five signatories must ratify the act before it becomes effective, the foundation of the Institute, which was expected by mid-1949, is still in abeyance; and the Interim Commission continues to function. The Brazilian Government has advanced $36000 to the Commission to continue preparatory work. It is suggested that the chief obstacle to the functioning of the Institute arises from objections made by Defence authorities in Brazil opposing the penetration of their country by international scientists.

* The Fourth General Conference of UNESCO, held at Paris in 1949, provided for an agreement with the I.I.H.A. to assure close co-operation between the two bodies, with UNESCO assistance in projects related to UNESCO's programme, with interchange of information and of staff, and with maintenance of common service and facilities.

High-Altitude Research

The proposal to establish high-altitude research stations was considered by a special conference convened by UNESCO at Interlaken in 1948 (This JOURNAL, *11*, 160). It was there agreed that, if plans for research laboratories and observatories under the auspices of United Nations are adopted, a high priority ought to be given to high-altitude stations. It was resolved that in the meantime I.C.S.U. should set up a Mixed Commission to facilitate exchange of information; that various organizations should be urged to give moral and financial support to the proposal; that existing stations should be organized into a network; and that travelling expenses should be paid to enable scientists to visit existing stations for research and study. No significant development has been reported since 1948.

Institute of the Arid Zone

A proposal for the establishment of an Institute of the Arid Zone was made by India in 1948 at the Third Conference of UNESCO. The Conference favoured the proposal, but was divided as to whether the establishment should comprise an *institute* of research stations, like that of the Hylean Amazon, or a *union* of affiliated organizations, with the function of co-ordinating their work and acting as a clearing house of information. UNESCO invited several of the international scientific unions to prepare reports on the proposal, and in August 1949 it called a meeting of a 'Special' Committee of Experts at Lake Success (taking advantage of the presence there of delegates to conferences on the Utilization of Natural Resources and on the Protection of Nature). The main Committee of Experts which was to be constituted by instruction of the Third Conference of UNESCO met in Paris on 5-7 December 1949. Dr. B. T. Dickson, Chief of the Division of Plant Industry, C.S.I.R.O., attended as delegate from Australia, with Mr. J. E. Cummins, Chief Scientific Liaison Officer of the C.S.I.R.O. in London, as alternate delegate.

The International Unions submitted enthusiastic and ambitious reports. The I.U. Geodesy and Geophysics proposed a number of immediate and short-term projects, leading to basic projects of long-term research which should comprise:

1. Sources of Energy: solar, wind, tidal, oil, atomic.
2. Sources of water: subterranean, wasted, salt, fresh-water boils in the sea, artificial rain, storage, long-distance transportation, fog and dew.
3. Sanitation and Health: climatic and geophysical factors affecting disease and pests; dust, heat, and other limitations to habitation.

The annual operating cost of the geophysical phases proposed for the programme was estimated as $770000. The I.U. Pure and Applied Physics, in a brief reply, mentioned the part to be played by physicists in research projects related to water and to energy; but for the moment proposed the employment only of a single qualified person to prepare a critical report.

The International Union of Geography outlined a programme as follows:

I. General Principles:
- (*a*) Definition of the arid zone and its distribution.
- (*b*) Classification and location of subdivisions.
- (*c*) Comparative survey of arid land surface characteristics.
- (*d*) Identification of climatic characteristics.
- (*e*) Investigation of the principles of resource utilization to include land use, water development and conservation; and principles of amelioration (floods, sand, dust, insects, glare, cold, diet, clothing, housing, inter-group tensions and dependence).

II. Studies of Specific Regions:
- (*a*) Survey of present conditions and trends to include natural environments and resources, and cultural factors.
- (*b*) Programme of assistance or development.

The I.U. Biological Sciences rendered a long, composite report under the following headings:

I. Agricultural Use:
- (*a*) The physical environment.
- (*b*) Organism and biological environment: to include a study of natural plant communities and their relation to climate and soil; biological balance of herbivores, carnivores, rodents, insects and vegetation; effects of insecticides, weedicides and fire upon vegetation; seed problems; utilization of cold desert and shrub areas.

II. Ecology:
- (*a*) Ecological research—
  - (i) Bio-meteorology and bio-climatology;
  - (ii) soil science (physics, chemistry and biology);
  - (iii) erosion (biological factors and biological control);
  - (iv) genetics (amplitudes of border-line ecotypes);
  - (v) bio-coenology (plant sociology).
- (*b*) Economical aspects—
  - (i) soil conservation;
  - (ii) pasturing;
  - (iii) agriculture;
  - (iv) forestry;
  - (v) relation of ecological research to hydraulic engineering, etc.;
- (*c*) Organization—
  - (i) research station network;
  - (ii) mobile desert stations;
  - (iii) international (university) chairs for ecology of arid regions.

III. Biology:
- (*a*) Bioclimatic cycles;
- (*b*) problems of the Sahara (inventory; bio-geography; biotopes, biocoenosia, microclimatic conditions; reaction of the organism);
- (*c*) desert and the human organism;
- (*d*) future modification of traditional economy.

The I.U. Theoretical and Applied Mechanics recommended that the objectives of an Institute should include:
- (*a*) Study of problems peculiar to the development of centres of modern civilization in arid zones.
- (*b*) Training programme to make the results of studies, and methods of their application, available to scientists and technicians.
- (*c*) Educational programme for inhabitants of arid zones.
- (*d*) Exchange of ideas between research organizations, including existing organizations and the new institute.

This Union recommended that the general scope of the activities of the Institute should comprise study of the following problems:

1. Water and Power Supply and Usage, to include protection from water erosion and wind erosion.
2. Agricultural problems, to include soil, land selection and utilization, suitable plants and animals, special production methods.
3. Problems of human occupation.

It recommended that the Institute should be made up of a Basic Research Centre, close to existing science research in a highly industrialized country, and Field Stations in arid zones of different characteristics, with circulation of staff between all of these.

The Australian National Co-operating Body for Natural Sciences met in November 1949 to brief Dr. Dickson before he attended the Committee of Experts. The N.C.B. was of the opinion that the first step should be the establishment of a modest clearing-house within the UNESCO secretariat, with an annual budget between £10000 and £20000; to be followed by specific surveys made by international teams in various countries. The N.C.B. urged that, as the Member States would have to provide finance, the Institute should be comprised of governments rather than of non-governmental scientific organizations;* and that care should be taken that work on the project done within the boundaries of a Member State should be done at the expense of that State, in so far as the State might be able to afford it.

The Committee of Experts was constituted of delegates from the United Kingdom, U.S.A., France, India, China, Australia, Israel, Turkey, Brazil and Egypt, together with observers from the United Nations and its specialized agencies, and from the International Scientific Unions and other significant bodies. The experts from the United Kingdom, Australia, France and Israel opposed the establishment of an 'institute' for reasons which included lack of personnel and of finance, whereas, in the early stages of discussion, the experts from India, French Morocco and French Sahara pressed very strongly for an institute. The Committee eventually recommended that an *International Council* should be set up to study the scientific and technical problems and resource development of arid and semi-arid areas; to have among its objectives the collection, collation and dissemination of research information; the preparation of a directory of relevant personnel and institutions; the exchange of personnel; the arrangement of conferences and symposia; and the study of possible programmes and means of basic and applied research. It was anticipated that this Council, which should be small in number and should be situated in a main centre, might perhaps operate for five years before any further step would be taken for the establishment of an institute. The proposals were strongly opposed by the United Nations observer, who appeared anxious to secure a definite establishment; their trend was very largely due to the advocacy of the Australian delegate. They will be submitted at Florence, in May 1950, to the Fifth Conference of UNESCO.

* See below, page 165.

International Computation Centre

Consideration of the possibility of an International Computation Centre, and of plans for its establishment, was resolved at Beirut by the 1948 Conference of UNESCO. To avoid the cost of summoning a committee of experts to report upon the proposal, the secretariat referred it to the National Research Council of U.S.A., which had initially been responsible for instigating it. A sub-committee from the N.R.C., under the chairmanship of Harlow Shapley, rendered a report to UNESCO in July 1949. It recommended that an 'International Mathematical and Statistical Consulting Centre' should be established, preferably located in one of the smaller countries of Europe (to stress its international character) and in a university town (for proximity to library and staff). The Centre should not instal one of the 'large' calculators, for reasons which include the present incomplete evolution of such instruments and the fact that they are (or will be) otherwise available in governmental institutions. Although the resident staff of the Centre would undertake 'routine' computing, the more important part of the project would be 'research' computing, for which the investigator himself would attend the Centre. The institution should serve as a counsellor in the design of investigations, in the setting up of problems for computation, and in the carry-

ing through of statistically evaluated researches. Its fields of service would include physics, mathematics, astronomy, general biology, public health, sampling, agriculture, fisheries, forestry, and various biological and economic researches.

The report of the N.R.C. committee recommended that, in addition to housing conference rooms and library, the Centre should be furnished with twenty 'desk' calculators of various capacities; punch-card equipment; one or more digital calculators built to order; and (if possible) a small differential analyser. The expense of inauguration, in addition to housing, might be $75000. The annual budget might include $50000 for resident staff, $50000 for research fellowships for a visiting staff of from twelve to twenty a year (a large proportion on short-term appointments), $50000 for maintenance and improvement of equipment, and other items bringing the annual total to $175 000, to be attained only after the first five years. A proposal that an international committee should be set up for the careful study of 'this project in international co-operation' will be submitted at Florence, in May 1950, to the Fifth Conference on UNESCO.

Conclusion

Following a long discussion upon the proposals for establishing the International Computation Centre, the Australian N.C.B. for Natural Sciences, at its meeting in March 1950, resolved:

> that it is undesirable to set up international laboratories except when objects cannot be achieved through national bodies acting either independently or in collaboration;
> that, in the event of a decision to set up an international laboratory, it should be placed under the aegis of one of the established international organization of pure and applied science.*

It is evident that motives prompting proposals for the establishment of international laboratories and institutions are very mixed. Representatives of the United Nations Organization have appeared at times to be urging proposals merely as a means of attaining international co-operation as such, and to be considering the immediate accomplishment of establishment as the chief factor to be desired. Scientists from less-developed countries have appeared (as in connexion with the Amazon, High-Altitude, and Arid Zone proposals) to be motivated, quite understandably, by a desire to bring strong scientific resources and activity into their own countries. Others who have furnished reports upon proposed projects may have been carried away by fervour for their own field of science, believing that they had at last encountered a hope of pouring material nourishment, as well as enhanced spiritual interest, into its life. On the other hand, it is evident that proposals for international scientific projects have met with hesitation or opposition arising from fear of, or resentment at, interference with existing institutions, including the possible dissipation of material and personal resources, and in some cases from fear of damage to national prestige, or of imperilment to national security. It has also been suggested that international laboratories should deal only with basic problems, and not with applications which might involve them in complications of patents and commercial interests.

Among those consulted by the United Nations in 1946-1947, Louis Bourgoin (Director of the Research Centre, Polytechnical School, Montreal) stated that 'the fact that an international spirit without ulterior motives does not exist; the individual pride of investigators which is partly legitimate; national pride which may easily become the sum of individual prides . . .' were among obstacles to the establishment of an international organization for general research. Another Canadian stated that 'until the idea of international co-operation is more fully developed among the nations of the world, the spirit of research can be more effectively fostered in national organizations'. Karl T. Comptom, of the Massachusetts Institute of Technology, stated:

> The major requirement of any undertaking of this sort would be the assembly of competent experts. . . . I believe that research scientists are likely to accept positions in the places where they believe the best opportunities for creative professional work will be available. Consequently, if international research laboratories are to be established, they would have to offer professional opportunities as good as, or better than, those which are offered by universities or industrial research laboratories or governmental bureaux which now command their services . . .

* This latter recommendation may be compared with that made by the same body three months before, regarding the Institute of the Arid Zone, reported above.

The project would be doomed to failure unless it could be entered into with such support and enthusiasm as to make a position in such a laboratory attractive to the scientists of the greatest competence. In some fields, such as medicine, this might be difficult because of the competition of some of the fine medical schools and research laboratories. . . . In other fields, like meteorology or astronomy or oceanography, I believe the competition would not be so severe and perhaps there would be a better opportunity for real success.

In any case it would seem best to concentrate the initial resources into a few very important fields where the opportunities seem to be greatest, and to do a really fine job in those fields.

Albert Einstein (at the Institute of Advanced Studies, Princeton) gave the following statements, in the course of his replies to questions, when consulted upon the subject by a representative of the United Nations:

There is probably no more urgent and indispensable institute to be set up under truly international and impartial auspices than a great centre of sociological studies . . . to establish a better understanding among nations. . . . Social studies of this kind are to be pressed forward with the utmost eagerness, for it is first in the minds of men that the conditions of a true international co-operation are to be sought; scientific and technical progress would mean little to mankind otherwise.

One should plan with the greatest caution for central laboratories or institutes in fields of scientific research, particularly as an institution of this sort may be brought under the influence of only one or two men with their own views, and too strict a discipline would do more harm than good to scientific work.

All the history of science shows that it is not through organization and planning that the great advances were achieved: the mind of some individual must get the spark, and, finally, the freedom of work of the individual scholar is the main condition of scientific progress. Organization is a poor instrument to find out new ways and means.

Animal Ecology

L. C. Birch*

Principles of Animal Ecology. By W. C. Allee, A. E. Emerson, O. Park, T. Park and K. P. Schmidt. (Philadelphia: W. B. Saunders Co., 1949. 837 pp., 263 text-figs. 7″ × 10″.) Price, £6. 13*s*.

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Within the last decade particularly, animal ecology has become a science in its own right. There was a period in its history when the wood could not be seen for the trees. That is the danger of any new science progressing on a wide frontier in search of principles. It is appropriate that this long-awaited text on animal ecology has incorporated the word 'principles' in its title, since it is the first text on the subject which has formulated clearly the many emerging principles of the new science. It is not an injustice to previous texts to say that they were either largely concerned with one or two principles of particular interest to their authors or else were inadequately integrated collections of facts. There will be less excuse for ecologists getting lost in the woods now that this book has appeared.

No one author could have achieved what the Chicago ecologists have succeeded in doing. The five authors have been closely associated for many years in making Chicago one of the great centres of ecological investigation in the modern world. It may seem strange to Australians that the central industrial city of the Middle West should foster a school of ecology; but it was the sand-dunes of the southern end of Lake Michigan which inspired Cowles of Chicago to develop for the world the principles of plant succession. Shelford later on discovered the tiger-beetle succession in the same area. It was from the Middle West that Clements went out to investigate the ecology of the prairies. Historically, the setting is appropriate; so too is the intellectual environment of Robert Maynard Hutchin's University.

Whoever reads *Principles of Animal Ecology* must be impressed with the scholarship which its authors show over a tremendously wide field of modern biological investigation. Source material is drawn from practically every branch of biology. The authors have been generous in their appraisal of historical ecology. They have shown how many studies which are regarded as essentially modern have their roots well in the past. The historical perspective both of the introductory historical chapter and in the book as a whole adds greatly to its capacity to inspire the reader. Much painstaking research has been put into the preparation of this history of ecology.

A central theme runs through the thirty-five chapters of the book. It is the realization of the population as an ecological unit and as an evolutionary unit. There was a stage in the development of animal ecology when the individual animal was isolated in the laboratory and subjected to all sorts of changes in the physical and chemical environment as though that constituted the sum total of the animal's ecological relationships. The recognition of the population as well as the individual, as an ecological unit, is a fundamental advance which is fully documented in this new text. The population, whether uni-

specific or multispecific, is viewed as a biological entity. It has a history. It is the population which is selected in evolution. It is the population which is adapted to its environment. The story reaches its climax in the final chapters specifically devoted to ecology and evolution.

The thirty-five chapters are divided between five major sections. Section I concerns the history of ecology to which reference has already been made. Section II, analysis of the environment, covers the more specifically physiological aspects of ecology. The effects of single factors such as heat, light, currents, gravity and biotic factors are all considered in separate chapters. This provides the setting for the more distinctive remaining sections, on Populations, the Community, and Evolution. Seven chapters on populations bring together much material which has hitherto been scattered and unintegrated. Principles are illustrated with examples from Protozoa to Man. One of the important contributions of this section is the discovery of principles and procedures which are applicable not only to insects or to man but to the gamut of the animal kingdom. Professor Thomas Park presents in this section an impartial account of the various schools, both 'biotic' and 'physical' which have from time to time engaged in violent controversy. In a sense this leaves the reader unconvinced as to the truth of any one school; but there is probable wisdom in such an approach, since it represents the state of our present knowledge on the difficult subject of population balance and control.

A fresh conception of the community is offered by Professor Orlando Park in the six chapters of Section IV. Here is a lucid account of modern conceptions of community ecology without extensive use of an elaborate terminology which, as the authors remark in the preface, helped to implant the facetious definition of ecology as that phase of biology primarily abandoned to terminology! Stratification of the community and periodism or cyclic changes are discussed in separate chapters. Perhaps the most stimulating chapter in this section is on community organization and metabolism; the concepts of food chains, food webs, pyramids of numbers, and biomass, lead on to a development of community energetics or the transformation of energy through the various trophic levels. At this level ecology becomes both complex and speculative. Park is well aware of the many difficulties in such a study and gives a timely warning that a simple food chain is rarely found under natural conditions; a point which is amply documented. Ecological succession is discussed primarily from a botanical point of view. This recalls a remark once made to the reviewer by the British ecologist, Charles Elton, that ecologists have difficulty in identifying any successions dependent primarily upon animal rather than plant activity.

Professor Emerson, the author of the final section, Ecology and Evolution, has had a profound influence on evolutionary thought through his writings and through his students in Chicago and as an able interpreter of Professor Sewall Wright of the same department. Now, for the first time, his original thought is brought together for the benefit of a wider community of biologists as well as those in his own country. The main factors influencing evolution, genetic variation, isolation and natural selection are discussed in turn. The treatment of the way in which environment influences a selective pressure on hereditary mechanisms has an originality about it. There is a great deal in these chapters which will stimulate genetical and ecological discussion, particularly the three conceptions 'habitat isolation', 'biotic barriers', and the inter-species system as an evolving unit. Disagreeing with Ernst Mayr, Emerson develops a case for habitat (ecological) isolation as initiating a process of speciation in certain instances. The reviewer finds his examples, which include the evolution of Mexican blind cave fish and variation in the gall wasp *Cynips*, particularly convincing. He has a strong case, too, in the insistence that partially isolated populations often show differences in gene frequency; selective pressure guiding these populations to ecologic adaptive divergence. Emerson maintains that there is much evidence to support the 'biotic barrier' concept, namely, that the integration of a natural community may be so closely knit as to offer a barrier to invading animals from outside the community. Competition with ecologically equivalent species is regarded as the most likely major biotic barrier in many cases. The evolution of inter-species integration is brilliantly handled, using parasitism and mutualism as simpler introductory examples. Most readers will find a great deal that is new to them in Emerson's discussion of Adaptation, particularly the evolution of behavioural adaptation in which he himself has made a special contribution to his life-study of termites. The terms of morphological evolution, such as symmetry, replication and homology, are applied with new meaning to behavioural evolution.

Principles of Animal Ecology is primarily a monumental treatise of a particularly strong school of animal ecologists in Chicago. Despite its size there are, of course, omissions of some important fields. The absence of a discussion of diapause (an important adaptation in many Australian species) and acclimatization (of equal importance in fresh-water fishery studies in Canada) are not to be regarded as inadvertent omissions. The authors have concentrated their attention on the fields of study in which Chicago has become distinguished; in itself an extraordinarily wide field of modern ecology. This obvious policy in the book as a whole has resulted in the production of an authoritative work of the highest quality. Ecologists will find this a contrast to some earlier texts which

suffered from superficiality through the author's lack of direct acquaintance with some of his material.

The bibliography contains nearly three thousand references. The index is thoroughly satisfactory. The numerous line drawings and photographs are all clear and the presentation as a whole is in keeping with the quality of the contents.

Zoologists both 'pure' and 'applied' will find *Principles of Animal Ecology* the most authoritative work now available for reference and for teaching purposes. A widespread use of this book in Australian zoology departments might herald the day when animal ecology is accorded a recognition comparable to that which it receives in zoology departments overseas.

A National Calibration and Testing Service

THE National Association of Testing Authorities is a voluntary association of calibration and testing authorities formed to assist members' laboratories to fulfil the needs of industry, commerce, and Commonwealth and State Governments. Such laboratories, while retaining their autonomy and continuing their normal functions, are authorized to endorse test certificates to show that the tests have been conducted by competent staff and on sound lines as approved by the Association. NATA aims to promote the recognition of these laboratories as impartial authorities whose test certificates will be accepted throughout Australia.

NATA was constituted in 1947 with the full support of the Commonwealth and all State Governments; the Commonwealth Government agreeing to finance its administration. The Commonwealth Scientific and Industrial Research Organization acts as liaison between NATA and the Commonwealth Government.

In 1937 the need for an adequate calibration service and a national testing authority was stressed by a committee with wide industrial representation appointed by the Commonwealth Government to report on testing and research for secondary industry. A number of recommendations from the committee were put into effect before World War II; but others, including the provision of a national calibration and testing service, were delayed by the onset of hostilities. NATA was formed when these proposals were revised in 1945, at a conference convened by C.S.I.R. (now C.S.I.R.O.).

Membership

Membership of the Association is voluntary and is open to Commonwealth and State Departments, to private firms, and to other organizations and persons operating testing laboratories. The organizations' laboratories must be approved by NATA for registration before membership is granted. Membership of NATA does not imply that a laboratory must undertake public testing.

Objects

The objects of the Association include the organization of a national service to provide calibration and testing facilities for industry, commerce, and governments, by the registration of existing laboratories on a voluntary basis; ensuring that testing equipment is calibrated in terms of the Commonwealth Standards of Measurement; the adoption of uniform methods of test; and generally the encouragement of the use of calibration and testing facilities in Australian industry.

Council and Executive Committee

A Council administers the affairs of the Association. It comprises representatives of the Commonwealth and of each State Government, the Associated Chamber of Manufactures, the Standards Association of Australia, and the State Committees of the Association, together with members co-opted because of outstanding scientific qualifications. The Executive Committee of this Council comprises the chairman, the vice-chairman, the representative of the Associated Chamber of Manufactures, and two other members of Council elected by the Council.

State Committees

In each State, a State Committee has been formed to advise the Council on NATA affairs within that State. The State Committees have been accepted by State Governments as advisers on all matters affecting public testing. Each State Committee consists of a State Government representative, representatives elected by the registered laboratories within the State, a representative of the Chambers of Manufactures, a representative of employees, and a representative of the Standards Association of Australia. The State Committees may also co-opt, as members, persons with special qualifications. Through the State Committee and their representatives on Council, registered laboratories will take an active part in the affairs of the Association.

Registration of Laboratories

NATA is accepting applications for registration in the following fields of testing:

1. Metrology
2. Mechanical Testing
3. Electrical Testing
4. Photometry
5. Temperature Measurement
6. Industrial Radiography
7. Chemical Testing
8. Biological Products Testing.

A separate application is required for each field of testing. Application forms and information on the classes of tests and calibration for which registration may be granted in each

field of testing (for example, in chemical testing the classes of tests include foods, rubber materials, and agricultural products) may be obtained from the head office of the offices of the State Secretaries of NATA.

The Council of the Association has appointed a Registration Advisory Committee for each field of testing. These Committees, which comprise specialists in the various fields, have determined the standards of staff, equipment, and laboratory practice required if registration is to be granted. The Committees, with the aid of assessors, investigate the staff, equipment, and laboratory practice of applicant laboratories for compliance with these standards. The names of the assessors visiting an applicant laboratory will be submitted to the laboratory. The Registration Advisory Committee makes a confidential report to the Council of NATA on the laboratory, with recommendations for or against granting registration, and in the latter case may recommend the steps to be taken by the laboratory to qualify for registration.

Registration is only granted for specified classes of testing and calibration, and is subject to the laboratory agreeing to abide by the requirements of the Constitution and Regulations of the Association. Registered laboratories must notify the Association of any change in the conditions under which registration was granted; for example, alterations to major items for testing equipment and changes in the responsible staff of the laboratory. The Association reserves the right to re-examine any registered laboratory.

Test Certificates

Registered laboratories may, if they so desire, use the emblem of the Association on test certificates for classes of test for which registration has been granted, together with the statement:

> This laboratory is registered by the National Association of Testing Authorities, Australia, for the classes of test herein reported.

This endorsement is an assurance that the tests have been conducted by competent staff, and on sound lines approved by the Association.

Information on NATA

Further information on NATA and the registration of laboratories may be obtained from the head office of NATA at 16 Wylde Street, Pott's Point, Sydney.

The Colonial Research Service*

A Colonial Research Service is this year to be established to operate within the parent body, the Colonial Service itself, which already includes functional services such as the Colonial Administrative Service, the Colonial Medical Service, the Colonial Education Service and others. The formation of the Colonial Research Service is evidence of the important place which research has taken in colonial administration since the end of World War II. Before 1939, several colonial institutions were at work, partly or wholly devoted to research; among them were the Institute for Medical Research in Malaya, the Imperial College of Tropical Agriculture in Trinidad, the East African Research Station at Amami in Tanganyika, and the Rhodes-Livingstone Institute in Northern Rhodesia. Under the Colonial Development and Welfare Act of 1945, one million pounds was to be set aside for research in each of the next ten years; then came the setting up of a Colonial Research Council by the Colonial Office, together with committees on the various branches of research, to advise on general policy and to co-ordinate the numerous research schemes included in development plans.

By March 1949 over three hundred schemes had been approved, trained staff and materials were coming forward, and the annual allocation of one million pounds under the Act had to be increased to two and a half million pounds. Research now being carried out or planned in the Colonies include agriculture, veterinary science, fisheries, medicine, forestry, the social sciences (anthropology, sociology and linguistics), and economics. One characteristic common to all of the research schemes is that they are practical, each designed to provide one much-needed answer. Their organization everywhere follows the same general pattern: the investigations are carried out either at special research institutions which are being built in the Colonies, or—and this applies particularly to research in the social sciences—by experts who are granted Fellowships to visit the areas concerned.

The minimum qualifications for appointment to the Colonial Research Service will normally be a good honours degree of a recognized Commonwealth university, and two years of post-graduate training, or of approved experience in scientific research. For officers engaged in medical research, the requirement is a medical qualification registrable in the United Kingdom; for officers engaged on veterinary research, a veterinary qualification also registrable in the United Kingdom.

The object has been to create a Service with salary and standards comparable to those for research workers in Britain, which will offer the research worker an opportunity of earning a continuous pension whether he spend all of his career in the Colonial Empire or only part of it. For research workers other than medical workers the basic salaries are identical with those laid down for the United Kingdom Scientific Civil Service; for medical research workers the scales are those approved by the Medical Research Council of Great Britain. In addition

* From matter compiled by Kenneth Bradley, author of *Diary of a District Officer*, and supplied through the United Kingdom Information Office.

to basic salary, an overseas research allowance is paid to compensate the worker for living abroad and to bring his total emoluments up to Colonial Service levels: this allowance varies from region to region. A Colonial Superannuation Scheme is in process of being drawn up to provide superannuation on a contributory basis.

The new Service will, of course, include officers in other branches of the Colonial Service who have been engaged on research work and are recommended by Colonial Governments. Like every other branch of the Colonial Service, it is open to properly qualified students from every nation and colony in the Commonwealth.

Stratigraphic Nomenclature

H. G. RAGGATT*

AT the Perth (1947) Meeting, the Australian and New Zealand Association for the Advancement of Science agreed to set up a Standing Committee on Stratigraphic Nomenclature. The Constitution of the Committee is given in This JOURNAL, *10*, 104, 1948. A summary of the events which preceded the setting up of the A.N.Z.A.A.S. Standing Committee on Stratigraphic Nomenclature is given in an earlier issue of This JOURNAL, *11*, 7, 1948.

The membership of the Committee is:

Queensland—Dorothy Hill,[a] C. C. Morton[b]
New South Wales—Ida A. Brown,[a], C. St. J. Mulholland[b]
Victoria—C. Teichert,[a] D. E. Thomas[b]
Tasmania—S. Warren Carey,[a] H. G. W. Keid[b]
South Australia—Douglas Mawson,[a] S. B. Dickinson[b]
Western Australia—Rhodes W. Fairbridge,[a] J. H. Lord[b]
Commonwealth—H. G. Raggatt (Acting-Secretary)†
Co-opted—Martin F. Glaessner[c]

Members distinguished by the symbol
[a] represent the State University;
[b] represent the State Geological Survey;
[c] represents geologists other than those employed by universities and official geological surveys.

It has not been possible for the Committee to meet, but the Acting-Secretary has been in touch with members orally or by correspondence. Several drafts of the proposed Code based in the first place on that prepared by Glaessner, Raggatt, Teichert and Thomas (This JOURNAL, *11*, 7-9, 1948) have been circulated and discussed formally or informally, so that the views of most Australian geologists concerning it are known.

As a result of this discussion the Committee has approved a *Code* and procedures which it recommends should be put into use forthwith. The Code is set out under numbered paragraphs to be known as *Articles*. In general each Article consists of two parts—a *Rule* (which is printed in italics) and a *Comment* by way of explanation or amplification of the Rule. Because the Code must stand the test of practical use and may therefore be modified from time to time, comment has been kept to a minimum.

At the end of the Code is set out the procedure which the Committee recommends should be followed to ensure its uniform application throughout Australia and the Territories.

* H. G. Raggatt, Acting Secretary of the A.N.Z.A.A.S. Standing Committee on Stratigraphic Nomenclature; Director, Bureau of Mineral Resources, Geology and Geophysics, 485 Bourke Street, Melbourne C.1, Victoria.

† Assisted by M. A. Condon, who spent considerable time studying literature and critically examining the wording of the Code.

Australian Code of Stratigraphic Nomenclature

I. INTRODUCTION

1. *To cover the practical needs of the stratigrapher in subdividing, classifying and naming stratigraphic sequences, three categories of* STRATIGRAPHIC TERMS *are required: time terms, time-rock terms, and rock terms.*

In nearly all types of geological field investigation individual rock units must be recognized, identified in the general rock succession, and correlated with units which were formed at the same time in other areas.

2. TIME *terms refer to divisions of geological time. All time terms taken together should, therefore, cover the whole of geological time.*

Time is continuous, whereas sedimentation or any other process of rock formation is not. Hence the division of geological time is essentially arbitrary and the breaks which determine the limits of a time-unit are not breaks in time but are due to changes of climate, tectonic environment, fauna and flora, which are reflected in the lithology, structure and palaeontology of the rocks on either side of the division in the time scale.

3. TIME-ROCK *terms are applied to the sum total of sedimentary and igneous rocks, irrespective of their lithology, formed during a period of time covered by the corresponding time term.* (See Article 19 concerning application to igneous rocks.)

Time-rock units may vary widely in lithology and fossil content but must everywhere contain rocks formed within a certain time interval.

4. ROCK *terms are required to designate stratigraphic units of a certain lithological uniformity which are easily recognizable as such in the field. They are defined and named with no special reference to their time of deposition.*

Rock units may (and do) vary from place to place with respect to the span of time they represent, and the fossils they contain.

II. Time Units and Time-Rock Units

5. Era *is the term applied to major subdivisions of geological time, e.g., Proterozoic Era, Palaeozoic Era, Mesozoic Era, etc.*

There is no generally accepted term for the rocks deposited during an Era. If required, the general terms 'succession', 'sequence', or 'rocks' may be used as time-rock terms, e.g., Mesozoic succession (the latter word without a capital letter).

6. Period *is the term applied to a major subdivision of an Era. The rocks deposited during a Period are called a* System, *e.g., Cambrian Period, Cambrian System. Period and System terms should preferably be of world-wide application, although this may not be possible in the case of the Pre-Cambrian.*

The names of the Periods are well known, but because stratigraphic knowledge grew slowly, and is still growing, the precise definition of many of the Periods and even the validity of some of them is still a matter of controversy. It seems probable that ultimately all Periods will have world-wide equivalence, but at present this is almost certainly not so.

7. Epoch *is the term applied to a major subdivision of a Period. The rocks accumulated during an Epoch are known as* Series, *e.g., Lower Devonian Epoch and Series. Epoch and Series terms should also preferably be of world-wide application, but terms of intracontinental validity may be used where correlation on a wider basis is difficult or impracticable.*

The term 'Epoch' has in the past been used in a general sense, and also in a particular sense for time intervals of varying length relative to the 'Period'. The term 'Series' has been even more thoroughly abused.

8. Age *is the term applied to a major subdivision of an Epoch. The rocks deposited during an Age are called a* Stage.

In theory, 'Age' and 'Stage', being respectively time and time-rock terms, identified on the basis of their fossil content or of that of the overlying and underlying beds, should be of world-wide applicability. In practice it is often impossible to correlate the rocks which have been deposited during such a comparatively short time in different parts of the world. In such cases it may be necessary to set up local time-scales in terms of local sequences for the smaller subdivisions of geological time, independent of the scales recognized elsewhere. Age and Stage terms established for local or intracontinental use should be abandoned as soon as definite correlation with one of the international units has been established beyond doubt.

9. Substage *is the term applied to a subdivision of a Stage.*

A Substage is likely to have appreciably narrower geographical limits than a Stage and only rarely will it be possible to make close correlation with similar units in other continents.

No standard terms for time divisions below the rank of Age are recommended. Terms have been suggested, but as their usefulness would be limited by the difficulty of precise correlation it seems inadvisable at this stage to introduce them. If required in a general sense a term such as 'Time' may be used.

10. *The term* Zone *should be used in a time-rock sense for strata containing a defined faunal or floral assemblage. A Zone should not exceed the magnitude of a Stage.* Zones are named after a characteristic genus or species, the name of the fossil being followed by the word 'Zone'. (E.g., *Nemagraptus gracilis* Zone.)

11. *The names of time and time-rock units are identical. Most names of Eras, Periods and Epochs are well defined and well known. Some names of Epochs and Series are derived from the names of the Periods and Systems of which they form part (e.g., Lower Devonian Epoch and Series); but in general they should be based on geographical names.*

To avoid confusion between rock terms on the one hand and time and time-rock terms on the other, it seems advisable to use an adjectival form of the names of time and time-rock units and therefore to select new names with this in mind. For this reason 'Artinskian Series' is preferred to 'Artinsk Series'.

III. Rock Units

12. *The* Formation *is the fundamental unit in the local mapping, classification, and description of stratified rocks.*

The term 'Formation' is to be restricted to the specific usage here defined. Such words as 'rocks', 'deposits' or 'sequence' may be used as general terms.

13. *The* sedimentary *Formation is defined as a lithological unit produced by essentially continuous sedimentation.*

The following criteria (based on Moore, *Bull. Amer. Assoc. Petrol. Geol.*, 32, 367, 1948) should be applied in establishing a Formation:

(*a*) *It must contain no evidence of an appreciable break in deposition.*

The presence of one or more beds of volcanic origin within a sedimentary sequence, or of an interruption due to contemporaneous erosion, is not evidence of an appreciable break in deposition if other supporting evidence is lacking. Palaeontology may afford the sole evidence of such a break.

(*b*) *Each Formation shall contain between its lower and upper limits either (i) rocks of one dominant lithological type or facies, e.g., sandstone, limestone, reef limestone, or (ii) repeated alternations of rocks of two or more*

lithological types or facies, e.g., sandstone and siltstone.

(*c*) *The Formation shall be discriminated and called by the same name as far as it can be traced and identified by means of its lithology particularly, but also by its stratigraphic association.*

It is not necessary that a Formation be of precisely the same age at different places.

(*d*) *The upper and/or lower contacts of a sedimentary Formation may transgress laterally horizons of neighbouring Formations, as long as its lithological identity is maintained and it can be recognized as an independent unit.*

(*e*) *The top and bottom of a sedimentary Formation are defined either by a change in lithology* (except as in *b.ii* above) *or by evidence of an appreciable interval of non-deposition.*

In a gradational succession it may be desirable to consider the passage beds as a separate Formation.

(*f*) *A Formation may contain one or more faunas or floras, provided that they do not indicate an appreciable time break within the Formation* (see *a.* above).

(*g*) *A sedimentary Formation may include minor developments of lavas, provided that they cannot be shown to mark an appreciable break in the process of sedimentation.*

(*h*) *Pyroclastic materials, whether deposited in water or on land, are to be regarded as volcanic sediments and hence may constitute Formations.*

14. The following rules should be observed in defining and naming Formations:

(*a*) *The name of a Formation shall consist of a* GEOGRAPHICAL *name coupled with a* LITHOLOGICAL *term which is descriptive of the rock, as is already widely done in Australia.* (*Examples: Gingin Chalk; Wianamatta Shale; Brighton Limestone; Bunya Phyllite.*) *The term 'Formation' shall be used as part of the name only where the lithology of the beds cannot be described adequately by one lithological term.*

Where insufficient geographical names are available, it is recommended that new names be given to geographical features, and that these be used as Formation names. (Any proposed new geographical names must be submitted to the proper authority—generally the State Surveyor-General—before being used in published work.) Particular care should be taken to avoid the use of often duplicated names, e.g., Sandy Creek, Sugarloaf Hill. Fossil names or rock characters shall not be used for the names of Formations, since Formations thus named may be confused with zones, or undue repetition of similar names may result.

(*b*) *Each new Formation that receives a formal name shall be explicitly* DEFINED *at the time of its proposal, though this rule shall not be construed as invalidating well-established names.*

The definition shall cite the geographic feature (and preferably its geographic co-ordinates) from which the name is taken. It shall also cite a specific locality, related to permanent features, at which the Formation is typically developed; and shall describe it in terms of lithology, thickness, and, if possible, fauna, flora, age, and relations to other Formations.

Workers in areas where rock-units have already been established should endeavour to retain as many of the formational names as practicable and to define them in accordance with the principles of this Code. It will be found that there are stratigraphic units which have been reasonably well described but not formally named. It is suggested that if the original worker is still living, the later worker in a particular area, or anyone revising its stratigraphic nomenclature, should give the original author the opportunity of selecting an appropriate name.

(*c*) *Subsurface units may be given formal names when such names are necessary for adequate presentation of the geological history of the region or when the subsurface section is materially different from equivalent exposed beds.*

The formal naming of subsurface units shall be governed by the same rules as prevail for surface units. In addition, representative samples of rock types and fossils, adequately labelled, shall be placed in an official permanent depository (State Mines Department, State Museum, Commonwealth Bureau of Mineral Resources, or University). This depository shall be referred to in the definition of the Formation, which shall also include a copy of all available logs—driller's, core-log, electrical, geochemical, etc.—in each case clearly showing the boundaries (and subdivisions, if any) of the proposed Formation.

15. *A Formation may be subdivided into lithologically distinct* MEMBERS, LENSES *or* TONGUES *according to the lateral extent of the subdivisions.*

No special rules shall apply to the naming of such subdivisions, which will usually be of purely local significance.

16. *The term* GROUP *may be applied to a sequence of two or more Formations.*

In constituting Groups, the objective is to indicate the natural relations of the Formations of a particular region. A sequence of unsubdivided strata may be called a Group when it is expected that it will be divided into Formations later. Rules for the naming of Groups shall be the same as those for Formations.

17. *The term* BEDS *shall be retained as a general term for sedimentary stratigraphic units or complex sequences which have not been well defined and are incompletely known as to thickness and detailed lithological succession.*

In the naming of Beds the same rules shall apply as for Formations. As far as practicable the original name shall be preserved if further investigation leads to a better definition of the sequence as Group, Formation or other unit.

18. *The rank of a unit, where circumstances dictate, may be changed without changing its name or its content of rocks.*

A rock-unit may change notably in thickness or character from one region to another; a Member may become a Formation or a Formation may become a Group (or vice versa). More detailed work may require that rank of some units be changed, e.g., a Formation may become a Group of several newly-named Formations.

In changing the rank, or re-defining the unit, the original name shall be used for only one unit, and as far as practicable should be applied to that part of the unit for which it was originally proposed.

19. IGNEOUS *and* METAMORPHIC *rocks should be classified and named according to the same principles as sedimentary rocks as far as stratigraphical methods can be applied to their study. The petrological character of such rocks will provide the basis for their definition as a Formation, e.g., Flinders Basalt.*

20. *To assemblages of volcanic rocks consisting of lavas and pyroclastic rocks of different kinds the term* VOLCANICS, *in conjunction with a geographical name, may be applied, e.g., Mt. Devlin Volcanics.*

21. *Where a large mass is composed mainly of diverse rocks including igneous and/or metamorphic rocks or is characterized by very complex structures the term* COMPLEX *may be used.*

22. *In case of synonymy the* RULE OF PRIORITY *shall apply; that is, if it is found that two authors have given different names to the same rock unit, the name chosen by the earlier author shall be the valid one.*

Application of this rule should be restricted to cases where no reasonable doubt exists as to the identity of the named Formations or other units and where the earlier name has been defined on the basis of field observations.

23. *A rock unit name shall not be used more than once. If it is found that two authors have used the same names for different units, the name which was published at the earlier date shall be the valid one.*

This rule shall apply only if the earlier name is based on field observations. In applying this rule to revision of rock-unit names published prior to the publication of this code, they shall be considered invalid only if confusion is likely to arise because of duplication.

24. *Both parts of the names of time, time-rock and rock units shall begin with* CAPITAL LETTERS.

This is in harmony with prevailing practice in British countries and is different from the American code, which uses capital initial letters for time and time-rock names but small initial letters for the lithological part of rock-unit names or the words 'formation', 'group', 'member', etc. The British practice has the advantage that it leaves no doubt when those words are used in a formal sense.

The use of formal terms, e.g., series, formation, etc., in a non-formal sense should be avoided, and the words 'sequence', 'succession', 'deposits', 'strata', substituted.

RECOMMENDATION

Authors of publications who desire advice on the application of this code should refer in the first instance to the two members of the Standing Committee representing the State concerned. If the question relates to a Commonwealth Territory, it is suggested that reference should be made to a Subcommittee consisting of the representative of the Bureau of Mineral Resources on the Standing Committee (as the official geological authority for Commonwealth Territories) and a specialist nominated by the Standing Committee. If the local members of the Standing Committee and the author are unable to reach a mutually satisfactory decision, the point or points in dispute should be referred to the Secretary of the Standing Committee, who shall place it before the full membership.

It is suggested that new formal names proposed should be submitted to the Secretary, who will consult all members of the Standing Committee with the object of avoiding, as far as possible, duplication of the use of similar place-names.

Taxonomy and Nomenclature*

EINFÜHRUNG IN DIE ZOOLOGISCHE NOMENKLATUR DURCH ERLÜNTERUNG DER INTERNATIONALEN REGELN. Second edition. Senckenberg-Buch No. 15. Frankfurt a.M., December 1948. 252 pp.

This book holds more than the title promises. The explanation and discussion of the 'International Rules' is preceded by a sixty-page introduction which contains many matters of general interest. Nomenclature is defined as

* See also, H. N. Barber: *Taxonomy*, a Letter to the Editor in this issue, page 184.

an essential tool of taxonomy. It is pointed out that although our present binominal system of nomenclature was initiated in 1758, generally binding international rules for its application were not introduced until 1905. The obligation to select types was not stated until 1907 and machinery for suspension of the Rules in certain cases was first provided in 1913. Since 1905 there have been no more than eighteen years of unrestricted international co-operation (1905-1914, 1927-1936) in which the applicability of the Rules could be tested. The author regards the Law of Priority and the obligation to select types as the fundamental principles of nomenclature without which fixation of name is an impossibility. Criticism against the form and severity of the Rules is rejected, because continuity of nomenclature is possible only by rigid application of an objective code.

An important chapter deals with the nomenclature of types and with the procedure of selecting holotypes and genotypes. As in previous publications the author suggests a reduction of type categories to true types, typoids and hyles, although the two last-mentioned conceptions have not gained wide acceptance. Of considerable interest is a chapter on the technique of the *nomenclature aperta*, which demonstrates how an author, by logical use of a few signs (cf., aff., ?) may make his taxonomical judgment abundantly clear. The introduction concludes with instructions to authors for the composition of manuscripts and the compilation of bibliographies, which may be read with advantage by the younger generation in any country.

The main part of the book (pp. 71-236) is devoted to a thorough discussion and interpretation of the International Rules on Zoological Nomenclature. The Articles of the Rules are reprinted one by one in German translation and the text of each article is followed by an analysis and interpretation of varying length. Most discussions are clear and very much to the point and the author does not fail to distinguish between the text of the Rules, the official recommendations attached to the Rules, the interpretation given by official pronouncements (opinions) of the International Commission on Zoological Nomenclature, and finally his own personal views and suggestions.

Some articles are discussed and interpreted at considerable length; e.g., the rules for the correct formation of generic and specific names (Articles 8 and 14), where most working taxonomists will find something from which they can benefit. Perhaps no other article of the Rules has given rise to more contradictory interpretation than Article 19, which leaves a wide loophole for changes in the original orthography of names in the case of typographical errors, errors of transcription and the like. Richter devotes eight pages to the discussion of this article and reference is made to a number of opinions on this subject.

Over twenty pages are given to the discussion of the Law of Priority under such subheadings as: 'What is a publication?', 'Principles of binary nomenclature', 'Definition of indication and diagnosis', and others. Considerable space is also given to the procedure of selecting genotypes and to the problems arising out of homonymy and synonymy.

An appendix contains the additions to the 'Official List of Generic Names', a list of genotypes fixed by the International Commission, and decisions about the availability for nomenclatural purposes of certain early publications. In the bibliography of six pages we miss some important references such as Schenck and McMaster's 'Procedures in Taxonomy' and D. L. Frizzle's 'Terminology of Types' (*Am. Midl. Nat.*, 14, 1933).

Every working taxonomist should keep Richter's useful book within easy reach.

CURT TEICHERT.

THE CLASSIFICATION OF ANIMALS. By W. T. Calman. (London: Methuen's Monographs on Biological Subjects, 1949. 51 pp. + index.) English price, 4*s.* 6*d.*

Calman's brief account of taxonomy provides a satisfactory introduction to systematic work. Its virtue lies in the fact that it is in no way a reference work to be consulted only in the face of difficulties, but may be read simply as a background to the more detailed and technical accounts of taxonomy available elsewhere.

Nevertheless Calman makes a number of salutary observations which are deserving of greater emphasis. In speaking of the classification of species in 'difficult' groups he says: 'There remains a minority, which in some divisions of the animal kingdom is not inconsiderable, which seems to defy specific classification. Of course, there is a strong temptation for the specialist to assure us that *he* can recognize species even where no one else can; but it is sometimes necessary to remind him that until he can convey to others by adequate description the exact nature of the differences on which he relies, his conviction of his own powers can contribute nothing to science.'

The author's approach to infra-specific categories is essentially practical and his advice on the presentation of a 'diagnosis' of a species epitomizes one of the most important aspects of taxonomic publication. A final point on which he has not hesitated to express his opinion is embodied in the following: 'The statement sometimes seen, *Type in author's private collection*, means that systematic zoology is being treated as a branch either of sport or commerce'.

Although a book on taxonomy, it should not be overlooked by students in other branches of biology—botanists as well as zoologists—who will find answers to at least some of those features of systematics which they find perplexing.

DAVID J. LEE.

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

22 April, 1950.

EDITOR: STEPHEN J. COPLAND, Linnean Society of N.S.W., Science House, 157 Gloucester Street, Sydney.

All communications concerning abstracts should be addressed to the Editor.

Vol. 27 **No. 6**

GEOLOGY.
Hon. Abstractor: R. O. Chalmers.

15046. **Teichert, C.** Upper Palæozoic of Western Australia: Correlation and Paleogeography. *Bull. Am. Assoc. Pet. Geol.*, xxv (3), 1941, 371–415.

15047. **Teichert, C.** Stratigraphy of Western Australia. *Bull. Am. Assoc. Pet. Geol.*, xxxi (1), 1947, 1–70.

15048. **Terrill, S. E.** A Grazing Incidence Method for the Determination of High Refractive Indices. *J. Roy. Soc. W. Aust.*, xxxiii, 1946–47, 53–57.—Attention is drawn to the Kohlrausch method of critical or grazing incidence in determining refractive indices, using a two-circle goniometer and a hollow prism. Although this method has been overlooked entirely by mineralogists, it offers certain advantages of speed and convenience over the minimum deviation method commonly employed.

15049. **Thomas, D. E.** A Critical Review of the Lower Palæozoic Succession of Tasmania. *Proc. Roy. Soc. Vict.*, lix (1), 1947, 23–52.—This paper is intended as a summary of the scattered literature on this problem. Attention is drawn to unsolved problems, to the need for fresh evidence and its study by modern palæontological and stratigraphical methods.

15050. **Tindale, N. B.** Subdivision of Pleistocene Time in South Australia. *Rec. S. Aust. Mus.*, viii, 4, 1947, 619–652. New evidence has accumulated and additional survey data has become available in regard to the ancient shorelines preserved on the low level plateau of the south-east of South Australia. In light of these additional facts a tentative local time scale for the Pleistocene is outlined, and this is correlated with the absolute chronology of Zeuner.

15051. **Whincup, Sylvia G.** A Preliminary Report on the Biology and Ecology of the Snowy River Area in North-Eastern Victoria. *Mem. Nat. Mus. Vict.*, xv, 1947, 150–154.—The writer has given a brief account of the geology of the area. This is part of the report which mainly comprises zoological notes by other members of the National Museum staff.

15052. **Wilson, A. F.** Some Observations on Depressions Resembling Meteorite Craters on Eyre Peninsula, South Australia. *Proc. Roy. Geog. Soc. Austr., South Aust. Branch*, xlviii, 1947, 25–36.—These occur in limestone country on Eyre Peninsula. In the absence of all the evidence of meteoritic origin, such as traces of meteoric material, fusion or sintering of country rock, etc., it is concluded that the lowering of the water table in the recent arid period may have caused collapse of the roofs of certain underground channels and caves.

15053. **Wilson, A. F.** The Charnockitic and Associated Rocks of North-Western South Australia. Part i. The Musgrave Ranges—An Introductory Account. *Trans. Roy. Soc. S. Aust.*, lxxi (2), 1947, 195–210.—A preliminary account of the geology of the area is given. Other papers are in preparation.

PALÆONTOLOGY.
Hon. Abstractor: H. O. Fletcher.

15054. **Brown, Ida A.** Lower Ordovician Brachiopods from Junee District, Tasmania. *J. Pal.*, xxii (1), 1948, 35–39.—A small collection of brachiopods from Junee district, Tasmania, made recently by S. Warren Carey and Eric Karmberg, is described. This is of interest in being the first record of the typical Lower Ordovician (Canadian) brachiopod genera *Tritoechia* and *Syntrophopsis* from the Southern Hemisphere. Three new species are described.

15055. **Crespin, Irene.** A Study of Australian Diatomites, with Special Reference to Their Possible Value as Filter Media. *Bur. Min. Res. Geol. and Geophysics*, Bull. 7 (Misc. Series 3), 1947, 1–40.—Samples from 46 deposits of the known 76 occurrences of diatomite in Australia have been micro-palæontologically examined, and 27 genera of diatomites represented by 48 species have been identified from them.

15056. **Crespin, Irene.** A Fossil Crab from the Lakes Entrance Oil Shaft, Gippsland, Victoria. *Proc. Roy. Soc. Vict.*, lix (1), 1948, 20–22.—A new species, *Harpactocarcinus victoriensis*, is described and is from the Janjukian Stage of the Middle Miocene.

15057. **Crockford, Joan.** Bryozoa from the Upper Carboniferous of Queensland and New South Wales. *Proc. Linn. Soc. N.S.W.*, lxxiii, (5–6), 1948, 419.—New species of Bryozoa from the Neerkol Series in Queensland and from a thin

marine intercalation in the freshwater Upper Kuttung Series in New South Wales are described.

15058. **Gill, E. D.** A Gens of Dalmanitid Trilobites. *Proc. Roy. Soc. N.S.W.*, lxxxii, 1948, 16.—Discussion of the genera *Dalmanites* and *Odontochile* in the Palæozoic rocks of eastern Australia. Two new species, *Dalmanites wandongensis* and *Odontochile formosa*, are described.

15059. **Gill, E. D.** A New Trilobite from the Yeringian (Lower Devonian) Rocks of Kinglake, Victoria. *Proc. Roy. Soc. Vict.*, lix (1), 1948, 8–19.—*Dicranurus kinglakensis*, sp. nov., is described and compared with *D. longispinus* (Mitchell) from New South Wales and *D. monstrosus* (Barrande) from Bohemia. The homologies of some parts are discussed, especially the genal spines. The Victorian beds containing *Dicranurus* are shown by the accompanying fossils to be Lower Yeringian in age. *Dicranurus* occurs in Devonian beds, except in New South Wales. *D. longispinus* is found in beds referred to the Silurian. The standing of the sub-genus *Bounyongia* is discussed.

15060. **Gill, E. D.** Eldon Group Fossils. *Rec. Queen Vict. Mus., Launceston*, ii (2), 1948, 57.—Descriptions of fossils from quartzitic sandstones outcropping in a road-cutting on the north side of the Lyell Highway, 100 yards east of the 12-mile post (east of Queenstown), Tasmania. Eight new brachiopod species are described.

15061. **Glaessner, M. F.** Decapod Crustacea (Callianassidæ) from the Eocene of Victoria. *Proc. Roy. Soc. Vict.*, lix (1), 1947, 1.—A description of *Callianassa bakeri*, n. sp., from Eocene strata recently recognized on the coast of Victoria, south-east of Princetown, followed by a discussion of fossil burrows of *Callianassa* in the Pebble Point beds.

15062. **Harris, W. J., and Thomas, D. E.** Victoria Graptolites, New Series, Part xi. *Min. Geol. J. Vict.*, iii (3), 1948, 43.—Places on record graptolites not previously recorded from certain horizons in Victoria and which from their rarity are likely to escape observation. In most cases the state of preservation and fragmentary nature of the material prevents definite determination.

15063. **Teichert, C.** New Nautiloids from the Older Tertiary of Victoria. *Min. Geol. J. Vict.*, iii (2), 1947, 48–51.—Two nautiloids are described, *Deltoidonautilus bakeri* and *Aturia* sp. nov., from a phosphate nodule deposit in the Clifton beds, forming the base of the Heytesbury formation. It is considered that the age of this deposit should not be older than late Oligocene.

15064. **Teichert, C.** Middle Devonian Goniatites from the Buchan District, Victoria. *J. Pal.*, xxii (1), 1948, 60–67.—The following goniatites are described : *Bactrites howitti*, n.sp., *Bactrites*, sp. ind., *Lobobactrites inopinatus*, n. sp., *Lobobactrites*, sp. ind., *Gyroceratites desideratus*, n. sp., and an indeterminate anarcestid. The fauna forms three distinct assemblages which are all closely related in age and indicate early Middle Devonian. It is the first goniatite fauna of this age to be described from the Australasian region.

15065. **Teichert, C.** Early Ordovician Cephalopods from Adamsfield, Tasmania. *J. Pal.*, xxi (5), 1947, 420–428.—A small fauna of endocerids from limestones near Adamsfield in south-western Tasmania, consists of the following species : *Piloceras tasmaniense*, n. sp., *Manchuroceras steanei*, sp. nov., *Manchuroceras excavatum*, n. sp., *Utoceras*, ? sp., *Suecoceras robustum*, n. sp., and *Endoceras* sp. This fauna includes the first pilocerids ever found in the Australasian region. It incidates the occurrence in Tasmania of beds of the age of the Beekmantown (Skiddavian of Britain and Wolungian of Manchuria). The paper includes a discussion of some aspects of the major classification of the Endoceroides and a description of some structural features of the siphuncle of *Manchuroceras*.

15066. **Teichert, C.** A Simple Device for Coating Fossils with Ammonium Chloride. *J. Pal.*, xxii (1), 1948, 102–104.

ZOOLOGY.

Hon. Abstractor : A. Musgrave.

15067. **Allan, Joyce.** The Brachiopods—Shelled Sea Creatures. *Aust. Mus. Mag.*, ix (10), Jan.-March 1949, 333–336, illustr.—A popular account of the Lamp Shells from Australian waters is here given.

15068. **Bertin, /L.** Catalogue des types de Poissons du Muséum National d'Histoire Naturelle. 2e partie. Dipneustes, Chondrostéens, Holostéens, Isospondyles. *Bull. Mus. nat d'Hist. nat.*, Paris, (2) xii (5–7), June-Dec. 1940, 244–322.

15069. **Boehm, E. F.** The Australian Raven (*Corvus coronoides*) in Relation to other Species of Birds. *S. Aust. Ornith.*, Adelaide, xix (3), Oct. 1948, 26–27.

15070. **Bryant, C. E.** More Observations on Nesting Avocets. *Emu* xlviii (2), Nov. 1948, 89–92, pl. 14.—*Recurvirostra novæ-hollandiæ* nesting on the salt works between Alton and Laverton, V.

15071. **Bryant, C. E., and Amos, B.** Notes on Crakes of the Genus *Porzana* around Melbourne, Victoria. *Emu*, xlviii (4), May 1949, 249–275, pls. 33–35.

15072. **Carnaby, I. C.** Variation in the White-tailed Black Cockatoo. *W. Aust. Nat.*, Perth, i (7), Dec. 1948, 136–138.—*Calyptorhynchus baudinii latirostris* subsp. nov. Hopetown, W.A., male adult, collected March 1948.

15073. **Chabanaud, P.** Notules Ichthyologiques. (3me série.) xii–xv. *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xiii (5), Nov. 1941, 414–421.—No. xv. Possible presence of *Solea ovata* Richardson in Australian waters.

15074. **Chabanaud, P.** Notules Ichthyologiques (Sixième série). *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xv, 1943, 289–293.—Synonymy of *Dexillus* Chab. and descriptions of other genera of soles (family Soleidæ). Of Australian interest are *Synclidopus* g.n. Orthotype, *Solea macleayana* Ramsay. Includes also *Aseraggodes normani* Chabanaud. *Haplozebrias* g.n. Orthotype, *Synaptura fasciata* Macleay. *Nematozebrias* g.n. Orthotype, *Æsopia quagga* Kaup. *Strabozebrias* g.n. Orthotype, *Synaptura cancellata* McCulloch, and including *S. craticula* McCulloch.

15075. **Cherbonnier, G.** Sur une Holothurie de Quoy at Gaimard type d'un nouveau genre : *Plesiocolochirus* n.g. *Bull. Mus. nat. d.Hist.*, Paris,

(2) xviii (3), May 1946, 280–286.—*Plesiocolochirus* n.g. Orthotype, *Holothuria spinosa* Quoy and Gaimard, 1833, from Port Jackson, Australia.

15076. **Clark, H. L.** A Report on the Echini of the Warmer Eastern Pacific based on the Collections of the Velero III. *Allan Hancock Pacific Exped.*, viii (5), 1948, pp. i-xii, 1–351, pls. 35–71, tfs. 1–3.—This posthumous paper includes an obituary of the author by F. A. Chase, Jr., and a bibliography of Dr. Clark's Echinoderm papers compiled by Marjorie Pattie. The paper is edited by Dr. Th. Mortensen of Copenhagen. References to Australian and species previously regarded as Australian will be found under *Brissus latecarinatus* (Leske), widely distributed throughout the Pacific, and *Meoma grandis* Gray, of the tropical eastern Pacific but originally described as from " Australia ".

15077. **Clarke, J. R.** Anatomy of the Quokka *Setonix brachyurus* (Quoy and Gaimard). *J. Roy. Soc. W.A.*, xxxiii, 1946–1947 (Oct. 15, 1948), 59–150, pls. i-ii, tfs. 1–36.—The external and internal anatomy is described together with notes on the natural history of this macropod.

15078. **Cooper, R. P.** Birds of the Capricorns—Great Barrier Reef. *Emu*, xlviii (2), Nov. 1948, 107–126, pls. 17–23.—Lists the birds of the Capricorn Group and brings together all the notes that have been published about them. Sixty-four species have been recorded which are divided into three groups : (1) regular species which include the sea-birds and a few mainland forms which nest on these islands, (2) waders which migrate to and from the Australian mainland each year, and (3) casual visitors which have been recorded over the years.

15079. **Copland, S. J.** Taxonomic Notes on the Genus *Ablepharus* (Sauria : Scincidæ). ii. The Races of *Ablepharus burnetti* Oudemans. *Proc. Linn. Soc. N.S.W.*, lxxiii (5–6), Jan. 1949, 362–371, pl. xxii, 12 tfs.—The species is recorded, apparently for the first time from New South Wales, about 600 miles south of any record previously known to the author. Specimens from New South Wales have been described as a new subsp. *sydneyensis*. *A. heteropus* Garman is here regarded as worthy of subspecific differentiation.

15080. **Cotton, B. C.** Australian Recent and Tertiary Mollusca. Family Volutidæ. *Rec. S. Aust. Mus.*, ix (2), May 1949, 181–224, pls. xiii-xvi.—Australian Recent and Tertiary Marginellidæ are completely revised—the recent species numbering 119 and the Tertiary 38, are arranged in seven groups. Four new Recent species are described, and 16 new species from the Tertiary—some of these last-named from bores in the Adelaide Plains.

15081. **Crowcroft, P. W.** A New Digenetic Trematode from the Barracouta (Syncoeliidæ-Digenea). *Pap. Proc. R. Soc. Tasm.*, 1947 (1948), 49–57, figs. 1–9.—Fam. Syncoeliidæ : *Capiatestes thyrsitæ* n.g. et sp. from near Nubeen, Tasm.

15082. **Crowcroft, P. W.** Notes on the Occurrence of the Nematode *Mermis nigrescens* Dujardin and its Effect on the Common Earwig in Tasmania. *Pap. Proc. R. Soc. Tasm.*, 1947 (1948), 59–62.—The Earwig, *Forficula auricularia* L., carries this nematode in its body cavity. It may be of economic importance in reducing the earwig population. The presence of the nematode larvæ prevents the formation of eggs during a period in which the females are normally producing offspring. The emergences of the nematode larvæ are responsible for a considerable number of deaths.

15083. **Dakin, W. J., Bennett, Isobel, and Pope, Elizabeth.** A Study of Certain Aspects of the Ecology of the Inter-tidal Zone of the New South Wales Coast. *Aust. J. Sci. Res.*, Melbourne, (B) i (2), May 1948, 176–230, pls. 1–9.—This paper constitutes an attempt to analyse basically the entire length of the New South Wales coast, with a zonation of plant and animal types for the intertidal region and the strip immediately above high-water mark. A series of indicator types is named and discussed with particular reference to the chief animal communities.

15084. **Ege, V.** *Chauliodus* Schn., Bathypelagic Genus of Fishes. A Systematic, Phylogenetic and Geographical Study. *Dana Report* No. 31, 1948, 1–148, 2 pls., 9 tfs.—*Chauliodus sloanei dannevigi* McCulloch, was earlier known under the name of *C. dannevigi* only from the type specimen described by McCulloch (1916) taken by the " Endeavour " 30 m. south of Cape Everard, V. It is shown to have a range to N. Zealand, N. Caledonia, Samoa and Fiji, and represents the West Pacific subspecies.

15085. **Fairbridge, W. S.** Fisheries. *Handbook for Tasmania* (A. N.Z. Ass. Adv. Sci., Hobart, Jan. 1949), pp. 67–76.

15086. **Fenaux, A.** Nouvelles espèces du genre *Conus*. *Bull. Inst. Ocean.*, Monaco, No. 814, 1–4, Jan. 1942, figs. 1–12.—*Conus incinctus* n.sp. Australia ; *C. nitidissimus* n.sp. Australia.

15087. **Fischer-Piette, E., and Beigbeder, J.** Catalogue des Types de Gastéropodes marins conservés au Laboratoire de Malacologie. iii. Purpura et genres voisins ; Tritonidæ. *Bull. Mus. nat. d'Hust. nat.*, (2) xv (6), Oct.-Dec. 1943, 429–436.

15088. **Fischer-Piette, E., and Beigbeder, J.** Catalogue des Types de Gastéropodes marins conservés au Laboratoire de Malacologie. iv. Fusidæ, Buccinidæ. *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xvi (1), Jan.-Feb. 1944, 70–77.

15089. **Fischer-Piette, E., and Beigbeder, J.** Catalogue des Types de Gastéropodes marins conservés au Laboratoire de Malacologie. v. Nassidæ, Vasidæ, Volutidæ. *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xvi (5), July-Sept. 1944, 321–330.

15090. **Fischer-Piette, E., and Lamy, E.** Note sur trois espèces de Veneridæ rangées par Lamarck dans le genre *Donax* Linne. *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xiv (1), Jan. 1942, 69–73.

15091. **Fischer-Piette, E., and Lamy, E.** Notes sur les Veneridæ (Moll. Lamellibr.) de Quoy et Gaimard. *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xiv (2), Feb. 1942, 130–137.

15092. **Fisher, W. K.** A Review of the Bonellidæ (Echiuroidea). *Ann. Mag. Nat. Hist.* (11) xiv (120), Dec. 1947 (Aug. 1948), 852–860, tfs. 1–5.—*Austrobonellia* g.n. described in key. Orthotype, *Archibonellia mjöbergi* Fischer, 1926.

15093. **Fleay, D.** Australia's Marsupial " Tiger Cat ". *Anim. Kingd.*, New York, li (2), April 1948, 36–41.

15094. **Fleay, D.** The Tasmanian Masked Owl. *Emu*, xlviii (3), Feb. 1949, 169–176, pls. 26–28.—*Tyto castanops*.

15095. **Fleay, D.** The Shy Australian Water Rat. *Anim. Kingd.*, New York, lii (2), March-April 1949, 54–58, illustr.

15096. **Fleay, D.** The Yellow-footed Marsupial Mouse. *Vict. Nat.*, lxv (12), April 1949, 273–277, pls. vii-viii.

15097. **Flynn, T. T., and Hill, J. P.** The Development of the Monotremata. Part vi. The Later Stages of Cleavage and the Formation of the Primary Germ-layers. *Trans. Zool. Soc. Lond.*, xxvi (1), July 1947, 1–151, pls. i-xxvii.

15098. **Fraser-Brunner, A.** A Classification of the Fishes of the Family Myctophidæ. *Proc. Zool. Soc. Lond.*, cxviii (4), Feb. 1949, 1019–1106, pl. i, 167 tfs.

15099. **Fraser-Brunner, A., and Whitley, G. P.** A New Pipefish from Queensland. *Rec. Aust. Mus.*, xxii (2), Jan. 1949, 148–150, tfs. 1–2.—Fam. Syngnathidæ: *Acentronura breviperula* sp.n. from Mabuiag, Torres Strait, compared with *A. tentaculata* Gunther, from Suez, the type of which is here figured for the first time.

15100. **Gabriel, C. J.** Additions to and Alterations in the Catalogue of the Land Shells of Victoria (including Descriptions of new Species). *Mem. Nat. Mus. Vict.*, No. 15, Oct. 1947 (=Aug. 1948), 109–125, pls. 9–10.

15101. **Gilbert, L.** Zoological Notes on the Northern Territory (June 1944 to September 1945). ii. Reef and other Marine Life. *Vict. Nat.*, lxv (6), Oct. 1948, 155–159.

15102. **Gilbert, L.** The Green Tree Ant in Science and History. *Vict. Nat.*, Melbourne, lxv (8), Dec. 1948, 196–199, pl. vi.—*Œcophylla smaragdina* var. *virescens*.

15103. **Glauert, L.** The Western Tiger Snake. *Notechis scutatus occidentalis* subsp. nov. *W. Aust. Nat.*, Perth, i (7), Dec. 1948, 139–141, figs.—Specimens have been collected at Albany, Brookton, Esperance, Fremantle, Gingin, Manjimup, Northam, Tambellup and Williams.

15104. **Grant, C.** Typhlops and Termites. *J. Ent. Zool.*, Claremont, Cal., xl (1), 1948, 14.

15105. **Gregory, W. K.** The Monotremes and the Palimpsest Theory. *Bull. Amer. Mus. Nat. Hist.*, New York, lxxxviii, Art. 1, 1947, 1–52, tfs. 1–17, pls. 1–2, tab. 1.—Points out that "the phyletic relationship between the platypus and the echidna is relatively close, so that they do not merit more than family separation. The echidna bears the marks of secondarily terrestrial derivation from the aquatic platypus stock, and it has retained the platypus method of moving the limbs, but swims as it were in a dense medium". Proposes a new subclass Marsupionta for the monotremes, removing them from the subclass "Ornithodelphia", and transferring their Order, Monotremata, to the new subclass.

15106. **Gudger, E. W.** Sizes Attained by the Large Hammerhead Sharks. *Copeia*, 1947, no. 4 (Dec.), 228–236, figs. 1–3.—Refers to *Zygæna leeuweni* recorded by Ogilby, 1886, a specimen having a length of 15 ft.

15107. **Gudger, E. W.** Pomacentrid Fishes Symbiotic with Giant Sea Anemones in Indo-Pacific Waters. *J. Roy. Asiat. Soc. Bengal*, xii (2), 1946 (1947), 53–76, pls. i-ii, tfs. A-C.—Observations include those made on the Great Barrier Reef and in north-western Australia and the symbiotic relationship is discussed in a thorough, historical manner, with bibliography.

15108. **Hale, H. M.** The Pigmy Sperm Whale (*Kogia breviceps* Blainville) on South Australian Coasts. *Rec. S. Aust. Mus.*, viii (4), Dec. 1947, 531–546, pls. xiv-xviii, tfs. 1–17.

15109. **Hale, H. M.** Australian Cumacea. No. 14. Further Notes on the Genus *Cyclaspis*. *Rec. S. Aust. Mus.*, ix (1), May 1948, 1–42, tfs. 1–21.—In addition to those already named, five new forms are described and figured: *C. juxta* sp.n. W. Australia; *C. sublævis* sp.n. W. Australia; *C. strumosa* sp.n. W. Australia, Queensland; *C. rudis* sp.n.; *C. brevipes* sp.n. W. Australia.

15110. **Hale, H. M.** Australian Cumacea. No. 15. The Family Bodotriidæ (Cont.). *Rec. S. Aust. Mus.*, ix (2), May 1949, 107–125, tfs. 1–9.—This paper deals mainly with Western Australian material. Apart from 15 species of *Cyclaspis* (dealt with by the author in a previous paper) only two members of the family were formerly known from the Indian Ocean coast of Australia. Nine species are added, including three described as new, viz. *Leptocuma nichollsi*, *Gephyrocuma similis* and *Sympodomma whitleyi*. A species recorded from S. Australia as *Sympodomma africana* Stebbing is now regarded as distinct and the name *S* (?) *incerta* is proposed for it. A composite key to the spp. of *Sympodomma* and *Glyphocuma* is given.

15111. **Hale, H. M.** Australian Cumacea. No. 16. The Family Nannastacidæ. *Rec. S. Aust. Mus.*, ix (2), May 1949, 225–245, tfs. 1–12.—The species are mostly from W. Australia. Fourteen spp. are listed, of which four are new, viz. *Nannastacus nichollsi*, *N. vietus*, *Schizotrema leopardina* and *S. resima*. *Cumellopsis australiensis* sp.n. is described from New South Wales, and the hitherto unknown female of *Campylaspis echinata* Hale is described and figured.

15112. **Hartman, Olga.** The Marine Annelids Erected by Kinberg with Notes on some other Types in the Swedish State Museum. *Ark. Zool.*, xlii (A) (1), 1949, 1–137, pls. i-xviii.—Australian species are redescribed and figured.

15113. **Hill, W. C. O.** Rhinoglyphics: Epithelial Sculpture of the Mammalian Rhinarium. *Proc. Zool. Soc. Lond.*, cxviii (1), May 1948, 1–35, 33 tfs.—Included in this paper are the rhinoglyphics of marsupials and a number of Australian species representing different families are described and figured.

15114. **Hindwood, K. A.** The Spangled Drongo in Victoria. *Vict. Nat.*, lxv (1), May 1948, 4–5.—*Chibia bracteata*.

15115. **Hindwood, K. A.** The Broad-billed Sandpiper in Australia. *Emu*, xlviii (2), Nov. 1948, 155–157, pl. 25, map of distr.—*Limicola falcinellus* gives particulars of the three known specimens collected in Australia.

15116. **Hindwood, K. A.** Mortality among Prions. *Emu*, xlviii (2), Nov. 1948, 167–168.—Fairy Prion, *Pachyptila turtur*, washed up in numbers on the beaches of the N.S.W. coast, particularly Yaegan Beach, near Seal Rocks, and Cronulla Beach, south of Sydney. Lists also Prions, Shearwaters and Petrels commonly found strewn on the beaches near Sydney.

15117. **Hindwood, K. A.** Sea-Bird Mortality. *Aust. Mus. Mag.*, ix (10), Jan.-March 1949,

329–332, illustr.—Records sea-birds found on Sydney beaches after storms in 1948 or those driven close to land by gales. Gives references and bibliography to this aspect of ornithology.

15118. **Holthuis, L. B.** The Decapoda of the Siboga Expedition. Part ix. The Hippolytidæ and Rhynchocinetidæ collected by Siboga and Snellius Expeditions, with remarks on other species. *Siboga Exped.*, Leiden, xxxix a[8], March 1947, 1–100, tfs. 1–15.—Lists the species of Hippolytidæ known up to Jan. 1943. Australian species are cited amongst the material examined.

15119. **Hubendick, B.** Studies on Bulinus. *Arkiv f. Zool.*, xl (A) (16), Oct. 1948, 1–63, 2 pls., 173 tfs.—The molluscan genus has been investigated to clear the phylogenetic position as viewed by different authors and the relations between the different groups comprised by it. About 25 species have been anatomically examined.

15120. **Iredale, T.** Western Australian Molluscs. *Proc. R. Zool. Soc. N.S.W.*, 1947–48 (Jan. 1949), 18–20.—The following species are dealt with: *Saxostria scyphophilla* (Peron), Shark's Bay; *Fragum hamelin* sp.n.; *Notovola preissiana* sp.n.; *Cetothrax* g.n. Orthotype, *Thracia alciope* Angas = *Anatina imperfecta* Lamarck; *Ninella whitleyi* sp.n. Geraldton; *Dryaspis* g.n. Orthotype, *Conus pontificalis* Lamarck = *Conus dorrænsis* Peron. *Campanile symbolicum* Iredale, King George's Sound; *Cabestanimorpha tabulata* (Menke).

15121. **Johnson, R. A.** The Food Supply of Marine Boring Organisms. *Port of Sydney J.*, ii (3), Jan. 1949, 92–95, illustr.

15122. **Johnston, T. H.** *Microphallus minutus*, a New Trematode from the Australian Water Rat. *Rec. S. Aust. Mus.*, ix (1), May 1948, 93–100, tfs. 1–8.

15123. **Johnston, T. H., and Angel, L. Madeline.** The Life Cycle of the Trematode *Echinoparyphium ellisi*, from the Black Swan. *Rec. S. Aust. Mus.*, ix (2), May 1949, 247–254, tfs. 1–3.—*Cercaria ellisi* Johnston and Simpson, 1944, from *Lymnæa lessoni* and *Simlimnea subaquatilis* from the Lower Murray region is the larval state of *Echinoparyphium ellisi*. The second intermediate hosts are various species of fresh-water molluscs; and tadpoles can also act as such under experimental conditions. Adult and growth stages from the upper intestine of the Black Swan, *Chenopis atrata*, are described, and the relation of *E. ellisi* to *E. gizzardai* Verma is discussed.

15124. **Johnston, T. H., and Beckwith, Anne C.** Larval Trematodes from Australian Freshwater Molluscs. Part xi. *Rec. S. Aust. Mus.*, viii(4), Dec. 1947, 563–583, tfs. 1–18.—*Cercaria* (*Furcocercaria*) *lessoni* n.sp. from *Planorbis isingi* Cotton, *Limnæa lessoni* Deshayes, and *Simlimnea subaquatilis* Tate; the metacercarial stage occurring in freshwater leeches, *Glossiphonia* spp.; the adult being probably an *Apatemon*. *Cercaria ameriannæ* sp.n. from *Amerianna pectorosa* Conrad; the metacercaria occurring in tadpoles of *Limnodynastes* sp. (experimental) and precociously, in *Amerianna pectorosa*; the unrecognized adult being a Diplostome, perhaps a *Tylodelphys*.

15125. **Johnston, T. H., and Clark, Helen G.** A New Cestode, *Raillietina* (*R.*) *leipoæ* from the Mallee Hen. *Rec. S. Aust. Mus.*, ix (1), May 1948, 87–91, tfs. 1–12.

15126. **Johnston, T. H., and Edmonds, S. J.** Australian Acanthocephala, No. 6. *Rec. S. Aust. Mus.*, viii (4), Dec. 1947, 555–562, tfs. 1–30.—Describes and figures *Filicollis sphærocephalus* (Bremser 1819) Trevassos, 1926, from the intestine of a sea-gull, *Larus novæhollandiæ*, at Henley Beach, S.A.; *Empodius alecturæ* n.sp. from the intestine of *Alectura lathami* from Eidsvold, Burnett River, Q., collected by the late Dr. T. L. Bancroft; *Prosthorhynchus charadrii* Yamaguti 1939, from the intestine of the bird, *Charadrius cucullatus*, from Waitpinga, S.A., collected by Prof. J. B. Cleland.

15127. **Johnston, T. H., and Mawson, Patricia M.** Some Avian and Fish Nematodes, chiefly from Tailem Bend, South Australia. *Rec. S. Aust. Mus.*, viii (4), Dec. 1947, 547–553, tfs. 1–7.

15128. **Johnston, T. H., and Mawson, Patricia M.** Some New Records of Nematodes from Australian Snakes. *Rec. S. Aust. Mus.*, ix (1), May 1948, 101–106, tfs. 1–8.—Among the forms cited are the following novelties: *Kalicephalus* sp. from the Ring Snake, *Furina occipitalis*, from the Burnett River, Q.; *Paraheterotyphylum australe* n.g. et sp. from a sea snake, *Hydrus platurus*, washed ashore at Little Bay, Sydney; *Tanqua ophidis* n.sp. from a fresh-water snake, *Natrix mairii* Gray (type host), collected in the north-eastern coastal region of Queensland by Dr. O. Tiegs; and from *Acrochordus javanicus*, Leichhardt River, N.Q.; *Physaloptera demansiæ* n.sp. from *Demansia psammophis*, Sydney.

15129. **Keast, J. A.** Field Notes on the Grey-tailed Tattler (*Tringa brevipes*). *Rec. Aust. Mus.*, xxii (2), Jan. 1949, 207–211.

15130. **Keast, J. A., and D'Ombrain, A. F.** Notes on the Little Pied Cormorant [*Microcarbo melanoleucus*]. *Proc. R. Zool. Soc. N.S.W.*, 1947–48 (Jan. 1949), 30–35, illustr.

15131. **Keast, J. A., and McGill, A. R.** The Sooty Shearwater in Australia. *Emu*, xlvii (3), Jan. 1948, 199–202, pl. 16, and map.

15132. **Kolosvary, G.** New Data of Cirripeds Associated with Corals. *Ann. Mag. Nat. Hist.*, (11) xiv (113), May 1947 (Feb. 1948), 358–368, tfs. 1–9.—Refers to spp. from Australia and the Pacific region.

15133. **Lamy, E.** Notes sur les espèces Lamarckiennes de *Cardium* (Moll. Lamellibr.). *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xiii (5), Nov. 1941, 458–463.

15134. **Lamy, E.** Notes sur les espèces Lamarckiennes de *Cardium* (Moll. Lamellibr.). *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xiv (1), Jan. 1942, 63–68.

15135. **Lamy, E.** Notes sur les espèces Lamarckiennes de *Cardium* (Moll. Lamellibr.) (suite). *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xiv (2), Feb. 1942, 126–129.

15136. **Lamy, E.** Notes sur les espèces Lamarckiennes de *Cardium* (Moll. Lamellibr.) (suite). *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xiv (3), March 1942, 228–232.

15137. **Lawrence, C. C.** An Occurrence of the White-fronted Tern in Tasmanian Waters. *Emu*, xlviii (4), May 1949, 325–326.

15138. **Lendon, A.** Parrakeet Breeding Results for 1946. *Avicult. Mag.*, liii (5), Sept.-Oct. 1947, 154–162.

15139. **Lendon, A.** Australian Parrots in Captivity. *Avicult. Mag.*, lv (2), March-April 1949, 44–58.

15140. **McGill, A. R.** The Need for More Definite Distribution Data. *Emu*, xlviii (2), Nov. 1948, 127–140, maps.—The author regards the geographic range of most Australian birds as inadequately expressed, and gives reasons and suggestions for more exact definitions of the range of a species or subspecies within a given area.

15141. **McGill, A. R.** Further Notes on the Great Knot. *Emu*, xlviii (2), Nov. 1948, 159–160.—*Calidris tenuirostris*—discusses the specimens collected in Torres Straits by the Chevert expedition in 1875, and of which three specimens of the original eight collected have still to be located.

15142. **Mackay, R.** The Australian Coral Snake. *Proc. R. Zool. Soc. N.S.W.*, 1947–48 (Jan. 1949), 36–37, illustr.—*Rhynchoelaps australis*—distribution, N.E. New South Wales; S. and S.-W. Queensland.

15143. **McLauchlan, C. F.** Experiments upon Certain Snails Inhabiting Sydney Gardens. *Proc. R. Zool. Soc. N.S.W.*, 1947–48 (Jan. 1949), 21–24, illustr.—Native Carnivorous Snail, *Strangesta capillacea* (Ferussac, 1822), which feeds upon the Common Garden Snail, *Helix aspersa*, but prefers natural foods such as the native snails, *Opeas tuckeri*, *Paralaoma* and *Egilomen*, and wet decayed vegetation. The introduced English Carnivorous Snail, *Helicella cellaria*, feeds on slaters and *Helix aspersa*.

15144. **Macpherson, J. Hope.** Records of Onchidiidæ (Mollusca, Gastropoda) from Victoria. *Mem. Nat. Mus. Vict.*, xv, Oct. 1947 (Aug. 1948), 172–173, pl. xiv.—*Onchidina australis* Semper, 1882, from Wingan Inlet, East Gippsland; *Onchidella patelloides* (Q. and G., 1832), Lorne, Point Addis, San Remo, Wye River.

15145. **Mackerras, M. J., and Ercole, Q. N.** Observations on the Development of Human Malarial Parasites in the Mosquito. i. Morphological Changes. *Aust. J. Exper. Biol. Med. Sci.*, xxvi (5), Sept. 1948, 439–447, pl. i (col.), tfs. 1–2.

15146. **Mackerras, M. J., and Ercole, Q. N.** Observations on the Development of Human Malarial Parasites in the Mosquito. ii. Factors Influencing Infection. *Aust. J. Exper. Biol. Med. Sci.*, xxvi (5), Sept. 1948, 449–458, tfs.

15147. **Mackerras, M. J., and Ercole, Q. N.** Observations on the Life-cycle of *Plasmodium malariæ*. *Aust. J. Exper. Biol. Med. Sci.*, xxvi (6), Nov. 1948, 515–519, 3 figs.

15148. **Mathews, G. M.** Correspondence. Nomenclature. *Emu*, xlviii (4), May 1949, 327–328.

15149. **Mitchell, F. J.** A Revision of the Lacertilian Genus *Tympanocryptis*. *Rec. S. Aust. Mus.*, ix (1), May 1948, 57–86, pls. iv–vi, tfs. 1–10.—In this survey of the agamoid genus *Tympanocryptis*, old and new forms are described and figured; among the latter are *T. intima* sp.n. from the Eyrean Basin; *T. maculosa* sp.n. unique in the genus, because of the presence of femoral pores extending along the thigh, inhabits the barren salty surface of Lake Eyre North (twenty specimens were taken by the late Dr. C. T. Madigan); *T. uniformis* sp.n. with uniform, instead of rugose, scalation, as in other species, from Darwin, N.T.; *T. lineata pinguicolla* subsp.n. a stout short-limbed race inhabiting parts of S. Victoria; *T. cephalus gigas* subsp.n., this W. Australian race inhabits the upland area bounded by the Gascoyne and Fortescue Rivers.

15150. **Mitchell, F. J.** A New Species of Lygosoma. *Rec. S. Aust. Mus.*, ix (2), May 1949, 180. *L.* (*Spenomorphus*) *tæniata*—Andamooka Ranges, west of Lake Torrens, S.A.

15151. **Mitchell, F. J., and Behrndt, A. C.** Fauna and Flora of the Greenly Islands, Part i. Introductory Narrative and Vertebrate Fauna. *Rec. S. Aust. Mus.*, ix (2), May 1949, 167–179, tfs. 1–2.—Notes are given concerning the physiological features and fauna of the little known group off the S. Australian coast. A scincid lizard, *Egernia whitii multiscutata*, is described as new. For an earlier paper on this group of islands, see *Austr. Sci. Abstr.*, No. 14813, Finlayson, H. H.

15152. **Mohr, E.** Einiges über Wombat-Formen und Marsupialia-Beutel. *Zool. Garten. Leipzig*, (N.F.), xiv, 1942, 55–68, 17 figs.—*Fide Zool. Rec.*, 1945 (1948), Mam., p. 29.

15153. **Munro, I. S. R.** Revision of Australian Silver Breams *Mylis* and *Rhabdosargus*. *Mem. Q'land Mus.*, xii (4), May 1949, 182–223, pls. xvi–xxiii, tfs. 1–5.—Six species of silver bream occur in Australian waters; five are referred to *Mylis* Lacépède and one to *Rhadbosargus* Fowler. The form from southern and south-western Australia, previously referred to *M. australis*, is described as a new species, and the first record is made of *M. latus* from Australia. The three species *M. australis*, *M. palmaris* and *M. butcheri* sp. nov. are restricted in distribution to Australia, while *M. berda*, *M. latus* and *R. sarba* have a much wider range. The limits of distribution of Australian species closely conform with the generally accepted marine faunal regions.

15154. **Nicholls, A. G.** Marine Biology in Western Australia. Presidential Address, 1947. *J. Roy. Soc. W.A.*, xxxiii, 1946–47 (Oct. 1948), 151–162.

15155. **Nicholson, A. J.** Presidential Address: Fluctuation of Animal Populations. *Rept. 26th Meeting Aust. N.Z. Ass. Adv. Sci.*, xxvi, Aug. 1947 (1948), 134–147.

15156. **Ormsby, A. I.** The Front-fanged Venomous Snakes of the Sydney Metropolitan Area. *Proc. R. Zool. Soc. N.S.W.*, 1947–48 (Jan. 1949), 25–29, illustr.—Deals with 12 species of which three are dangerous to human life, viz. the Tiger Snake, the Death Adder and the Brown Snake; two species are capable of producing a nasty and painful bite, the Blake Snake, and the Broad-headed Snake; the remainder are harmless to man.

15157. **Panning, A.** Die Trepangfischerei. *Mitt. Hamburg Zool. Mus. Inst.*, xlix, 1944, 2–76, 40 tfs.—Refers, *inter alia*, to the Australian beche-de-mer fisheries and lists the species concerned, giving the scientific and vernacular names. Elsewhere he treats with the various genera and species of these edible Holothuriidæ from a taxonomic viewpoint.

15158. **Perry, D. H.** Black Cockatoos and Pine Plantations. *W. Aust. Nat.*, Perth, i (7), Dec. 1948, 133–135, illustr.—*Calyptorhynchus baudinii*, White-

tailed Black Cockatoo, extracting the seeds from the cones of *Pinus pinaster* for food.

15159. **Plomley, N. J. B.** Zoology in Tasmania. *Handbook for Tasmania.* (A. N.Z. Ass. Adv. Sci., Hobart), pp. 45–50, 1949.

15160. **Pope, Elizabeth C.** Hitch-Hikers of the Sea. *Aust. Mus. Mag.*, ix (9), Oct.-Dec. 1948, 293–297, illustr.—Mentions the following marine animals—Barnacles: the Australian Barnacle, *Elminius modestus*, now known from England and Europe; *Lepas anatifera*, *L. hilli*, *L. anserifera* and *L. pectinata*. The Wandering Crab, *Planes minutus*. The Brown Anemone, *Calliactis miriam*. The Amphimid Worm which travels on pumice stones.

15161. **Pope, Elizabeth C.** Crangon—The Noisy Pistol Prawn. *Aust. Mus. Mag.*, ix (10), Jan.-March 1949, 326–328, illustr.—*C. strenuus* occurs on open coast of New South Wales; *C. edwardsii* in muddy areas of the estuaries of New South Wales among eel-grass or under stones.

15162. **Robinson, A.** The Biological Significance of Bird Song in Australia. *Emu*, xlviii (4), May 1949, 291–315, illustr.

15163. **Serventy, D. L.** The Great-winged Petrel in Western Australia. *Pterodroma macroptera. Emu*, xlvii (3), Jan. 1948, 211–213.

15164. **Serventy, D. L.** The Tasmanian Mutton-bird in Western Australia. *W. Aust. Nat.*, Perth, i (6), Sept. 1948, 131.—*Puffinus tenuirostris.* Washed up on the beach, five miles west of Starvation Boat Harbour, near Hopetoun, W.A. (1946), the first record from W. Australian seas. Also on the beach at Esperance (1948).

15165. **Serventy, D./L., and Whittell, H. M.** A Handbook of the Birds of Western Australia (with the exception of the Kimberley Division). 8vo. *Perth*, W.A., 1948, pp. 365, illustr.—A chapter is devoted to the history of ornithology in W. Australia, while another section is devoted to bird geography. The remainder of the book treats with the birds in their systematic order, and gives aboriginal names, field recognition marks, distribution, nesting and migrations.

15166. **Springer, S.** *Sphyrna bigelowi*, a New Hammerhead Shark from off the Atlantic Coast of South America, with Notes on *Sphyrna mokarran* from New South Wales. *J. Wash. Acad. Sci.*, xxxiv (8), Aug. 1944, 274–276, fig. 1.—Measurements of a female embryo hammerhead shark from New South Wales are tabulated in comparison with a new species from Uruguay and Brazil.

15167. **Sproston, Nora G.** A Synopsis of the Monogenetic Trematodes. *Trans. Zool. Soc. Lond.*, xxv (4), Dec. 1946, 185–600, tfs. 1–118.

15168. **Stokell, G.** The Validity of *Galaxias kayi* Ramsay and Ogilby. *Rec. S. Aust. Mus.*, viii (4), Dec. 1947, 671–672.

15169. **Stresemann, E.** Die Gattung *Corvus* in Australien und Neuguinea. *J. Ornith*, Berlin, xci, 1943, 121–135.—*C. difficilis* sp.n., Queensland. *Fide Zool. Rec.*, lxxxii, 1945 (1948).

15170. **Tarr, H. E.** Notes on the Birds of Long Island, Abrolhos Group, Western Australia. *Emu*, xlviii (4), May 1949, 276–282, pls. 36–38.

15171. **Tate, G. H. H.** Results of the Archbold Expeditions. No. 60. Studies in the Peramelidæ (Marsupialia). *Bull. Amer. Mus. Nat. Hist.*, New York, xcii (6), Nov. 1948, 313–346, tf. 1, tabs. 1–10.—The Australian species are included in this monograph.

15172. **Tesch, J. J.** The Thecosomatous Pteropods. ii. The Indo-Pacific. *Dana-Report*, No. 30, 1948, 1–45, 3 pls., 34 tfs.—The majority of the species dealt with are recorde from Australian waters, notes are given on the species, together with maps of their distribution.

15173. **Thompson, H.** Fish Welfare. *Pap. Proc. R. Soc. Tasm.*, 1947 (1948), 1–19, pls. i-iii, tfs. 4.

15174. **Tixier-Durivault, A.** Les Alcyonaires du Muséum: I. Famille des Alcyoniidæ. I. Genre *Lobularia*. *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xv (6), Oct.-Dec. 1943, 437–443.—*L. bottai* n.sp., Wooded Island, W.A.; Red Sea; *L. dollfusi* n.sp., Abrolhos Is., W.A.; Red Sea.

15175. **Tixier-Durivault, A.** Les Alcyonaires du Museum: I. Famille des Alcyoniidæ. II. Genre *Sinularia*. *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xvii (1), Jan. 1945, 55–63.

15176. **Tixier-Durivault, A.** Les Alcyonaires du Museum: I. Famille des Alcyoniidæ. II. Genre *Sinularia* (Suite). *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xvii (2), Feb. 1945, 145–152.—*S. riobusta* MacFadyen, 1936, Reef A, Lizard Is.; Outer Moat, Yonge Reef, Low Is.; *S. variabilis* n.sp., Talaut I.; Rotti I.; Low I.; Red Sea; Gambier Is.; Toumotous.

15177. **Troughton, E.** The Marsupial Banded Ant-eater or Numbat. *Aust. Mus. Mag.*, ix (9), Oct.-Dec. 1948, 298–302, illustr.—*Myrmecobius fasciatus*.

15178. **Webber, L. C.** The Ground Parrot in Habitat and Captivity. [*Pezoporus wallicus*]. *Avicult. Mag.*, liv (2), March-April 1948, 41–45, pl.

15179. **Webster, H. O.** Field Notes on *Malurus elegans*, the Red-winged Wren of Western Australia. *Emu*, xlvii (4), March 1948, 287–290, pls. 19–20.

15180. **Whitley, G. P.** A List of the Fishes of Western Australia. *Fish. Dept. W.A.*, *Fish. Bull.*, No. 2, 1948, 1–35, map.

15181. **Whitley, G. P.** Flounders and Soles. *Aust. Mus. Mag.*, ix (11), April-June 1949, 378–384, illustr.

15182. **Whittell, H. M., and Serventy, D. L.** A Systematic List of the Birds of Western Australia. *Publ. Libr. Mus. and Art Gall. W.A.*, Special Publ., No. 1, 1948, pp. vi, 126.

BIOCHEMISTRY.

Hon. Abstractor: G. F. Humphrey.

15183. **Albert, A., and Falk, J. E.** The Formation of Hydrogen Carriers by Hæmatin-Catalyzed Peroxidations. i. Hydrogen Carriers from Certain Acridine and Quinoline Compounds. *Biochem. J.*, xliv, 1949, 129.—*In vitro*, cytochrome C and methæmoglobin catalyze the oxidation by hydrogen peroxide of certain amino- and hydroxy-acridines and quinolines. The oxidized products act as hydrogen ascorbic acid or cysteine.

15184. **Beck, A. B., and Sheard, K.** The Copper and Nickel Content of the Blood of the Western Australian Marine Crayfish (*Panulirus*

longipes Milne Edwards) and of Seaweeds. *Aust. J. exp. Biol. Med. Sci.*, xxvii, 1949, 307.—The copper content of the blood varies from 43 to 208 μg./ml. and nickel was present only in traces. The seaweeds contained 1·6 to 10 p.p.m. copper and 1·6 to 25 p.p.m. nickel.

15185. **Bolliger, A., and Peters, F. E.** Pentoses in Hair. *Aust. J. Sci.*, xi, 1949, 174.—Nearly all the reducing substance in rabbit fur is pentose. In some other animals (rat, cat, sheep and man) there is not such close agreement. Phalanger fur contains large amounts of reducing substances (up to 0·9%) but no pentose.

15186. **Callaghan, J. P.** Mesohæmoglobin Derivatives. 2. A Green Derivative of Mesohæmoglobin in the Presence of Cyanide. *Aust. J. exp. Biol. Med. Sci.*, xxvii, 1949, 281.—When mesohæmiglobin cyanide is alternately reduced by dithionite and oxidised by oxygen in the presence of excess buffered cyanide, a green solution containing several hæmoproteins is obtained. It is suggested that the solution contains mesocholeglobin, a meso-oxyporphyrin derivative and a new pigment. The production of cruoralbin, by subjection of hæmoglobin to the same reaction, involves participation of the vinyl side-chains of the porphyrin.

15187. **Callaghan, J. P., and O'Hagan, J. E.** Mesohæmoglobin Derivatives. 1. Preliminary Studies on the Preparation and the Properties of Mesocholeglobin. *Aust. J. exp. Biol. Med. Sci.*, xxvii, 1949, 275.—The coupled oxidation of mesohæmiglobin and ascorbic acid produces mesocholeglobin, which has properties similar to choleglobin. The formation of choleglobins does not require the presence of vinyl side-chains in the molecule.

15188. **Davison, D. C.** The Distribution of Formic and Alcohol Dehydrogenases in the Higher Plants, with Particular Reference to their Variation in the Pea Plant during its Life Cycle. *Proc. Linn. Soc. N.S.W.*, lxxiv, 1949, 26.—Of the 93 species examined, 54 contained formic dehydrogenase and 69 alcohol dehydrogenase. All of the *Leguminosæ* contained formic dehydrogenase, whether or not nodules were present.

15189. **Davison, D. C.** The Importance of Formic Dehydrogenase in the Oxidation Mechanisms of *Pisum sativum*. *Proc. Linn. Soc. N.S.W.*, lxxiv, 1949, 37.—In the seed and seedling, alcohol and formic dehydrogenases are probably the first enzymes concerned in the chain of biological oxidation of substrates. Formic dehydrogenase can be coupled with other dehydrogenases. Formate oxidation can proceed through the cytochrome and ascorbic acid oxidases in the seed and seedling respectively.

15190. **Dawbarn, Mary C.** The Determination of Thiamine in White Bread by the Thiochrome Method. *Aust. J. exp. Biol. Med. Sci.*, xxvii, 1949, 207.—It was found that acid extraction of bread followed by enzymic digestion of the filtrate gave satisfactory removal of thiamine from the sample. Details of the fluorimetric procedure adopted for the estimation are described.

15191. **Ennor, A. H., and Stocken, L. A.** The Preparation of Sodium Phosphocreatine. *Biochem. J.*, xliii, 1948, 190.—Creatine hydrate and phosphorus oxychloride are condensed together and the product purified through the barium salt.

15192. **Falk, J. E.** The Formation of Hydrogen Carriers by Hæmatin-Catalyzed Peroxidations. *Biochem. J.*, xliv, 1949, 369.—The oxidation of adrenaline by oxygen at pH 7 is catalyzed peroxidatively by cytochrome C and by methæmoglobin. Adrenochrome can act as a hydrogen-carrier in catalyzing the oxidation of ascorbic acid by oxygen.

15193. **Hackman, R. H., Pryor, M. G. M., and Todd, A. R.** The Occurrence of Phenolic Substances in Arthropods. *Biochem. J.*, xliii, 1948, 474.—Phenolic acids are believed to play a part in the hardening of insect cuticle ; 3 : 4-dihydroxyphenylacetic acid was isolated from six species and in addition 3 : 4-dihydroxybenzoic acid from two of these species.

15194. **Hackney, F. M. V.** Studies in the Metabolism of Apples. vii. A Study of the Polyphenolase System in Apples. *Proc. Linn. Soc. N.S.W.*, lxxiii, 1948, 439.—Protocatechuic acid increases the oxygen uptake of cut apple tissue ; sometimes more oxygen was consumed than was required for the oxidation of the protocatechuic acid. It was concluded that the acid could act as a catalyst under some conditions. Resorcinol and cyanide strongly inhibit the respiration of apple tissue. A crude apple polyphenoloxidase preparation was made with a Q=84.

viii. Ascorbic Acid Oxidase in Apples. *Ibid.*, p. 455.—Ascorbic acid oxidase is present in apple tissue and can be inhibited by 0·001 M cyanide. The possible function of the enzyme as a terminal oxidase is discussed.

15195. **Hird, F. J. R.** Amino Acids in Tobacco Mosaic Virus. *Aust. J. Sci.*, xi, 1949, 170.—Using the methods of paper chromatography, tobacco mosaic virus was analysed for the presence of a number of amino acids. The results confirmed those obtained previously by other workers using microbiological methods. In addition, it was shown that hydroxyproline is not present.

15196. **Humphrey, G. F.** The Adenosinetriphosphatase Activity of Myosins from Marine Animals. *Physiol. Comp. Œcol.*, i, 1949, 89.—Myosin was prepared from various marine animals and shown to have ATP-ase activity of a low order.

15197. **Humphrey, G. F., and Mann, T.** Studies on the Metabolism of Semen. v. Citric Acid in Semen. *Biochem. J.*, xliv, 1949, 97.—Castration lowers the level of seminal citric acid, and this effect can be offset by treatment with testosterone. Rat seminal vesicles, despite their high content of citric acid have little ability to synthesize citric acid from oxaloacetic acid.

15198. **Isbister, J.** The Estimation of Serum Albumin by the Precipitation of Globulin with Sodium Sulphite. *Aust. J. exp. Biol. Med. Sci.*, xxvii, 1949, 61.—The Campbell and Hanna method (21% sulphite as precipitant) was checked against the standard Howe procedure. For clinical purposes the former method is recommended owing to its speed and simplicity.

INTERNATIONAL RULES OF BOTANICAL NOMENCLATURE. Compiled by W. H. Camp, H. W. Rickett and C. A. Weatherby. (Waltham, Mass.: The Chronica Botanica Co.; Melbourne: N. H. Seward and Co. 120 pp. 7" × 10½".) Price, $3.50.

The Chronica Botanica Company is to be congratulated for reprinting the limited edition of the International Rules of Botanical Nomenclature published in *Brittonia* 6, No. 1 (1947). The last published edition of the Rules was the Third Edition, published in 1935; but later in that year several alterations were made at the International Congress held at Amsterdam. These alterations were known to few botanists, and in any case relatively few copies of the Third Edition are available. To fill this need, the work under review was inspired by the American Society of Plant Taxonomists.

The volume is well printed, the list of *nomina conservanda* has been brought up to date, a list of *nomina rejicienda* has been compiled—a welcome innovation—and a comprehensive index is included. Alterations from the Third Edition sanctioned at Amsterdam are indicated by dots in the case of deletions and by a change of type in the case of altered wording and additions. In the preface, the compilers state that 'It is to be clearly understood that the present text, although taken from authentic sources, is in no way to be considered an official edition. Its compilers have attempted to be as careful as possible . . . but there is no warrantry that the text in all its parts is as originally intended . . .'.

Since this publication was received, there has come to hand a copy of *International Rules of Botanical Nomenclature, Supplement, Embodying the alterations made at Amsterdam in 1935*, by T. A. Sprague, 1948 (mimeo'd). This is the official text of the alterations made at Amsterdam. There are occasional differences between the American version and this, but for the most part they are relatively unimportant textual emendments made by the Editorial Committee. The chief differences are:

(*a*) the phrases relating to provisional names are treated in the American version as an addition to Art. 37 instead of a separate Article, Art 37 *bis*; and there is no reference to alternative names;

(*b*) the text of Rec. XXXII *ter* is omitted because it had been 'referred to the Editorial Committee';

(*c*) the wording of Rec. XXXII *septies* is different;

(*d*) some provisions relating to fossil plants are differently arranged.

(In the official Supplement, Art. 39 is replaced by Art. 42 *bis* and Art. 44 *bis*; two new Articles, Art. 44 *bis* and Art. 46 *bis* are added; and additions are made to Art. 37 and Art. 57.)

Such a complete presentation of the Rules of Nomenclature will be warmly welcomed.

S. T. BLAKE.

Genetics

S. SMITH-WHITE*

HEREDITY, EAST AND WEST—LYSENKO AND WORLD SCIENCE. By Julian Huxley. (New York: Henry Schuman, 1949. 246 pp.) Price, $3.00.

Here is a book dealing with the Russian Genetics 'controversy' which should be read by all biologists, by all scientists, and by all who have an interest in the relation between Science and Society. It can be recommended to all libraries and all reading groups.

The reader not already familiar with the situation of Genetics in Russia will require information on several aspects. Firstly, what *is* the controversy? What is it about? Second, what conclusion is to be reached, at the scientific level, as a result of the conflict? Is the orthodox geneticist correct, or are Lysenko and his followers nearer the truth? Are neither sound, or are both, in part? And third, what is the significance of the controversy, other than at this genetical level? Julian Huxley deals with these aspects over the six chapters of his book, but he emphasizes that the third aspect is of major importance. In Russia the curtain has been rung down on a tragedy with the complete defeat of orthodox genetics. Elsewhere, the Lysenko-ist doctrine of the inheritance of environmental modifications is rejected by all who are familiar with the factual basis of neo-Mendelian and neo-Darwinian theory. The significance of the controversy is, as it must be, in the broad sense, political.

Chapter 1 outlines the nature and history of the dispute from its appearance, even before 1930, to its conclusion at the Genetics Congress of the U.S.S.R. Academy of Sciences in 1948, and provides the necessary introduction to the subsequent discussion. Then in Chapter 2 the ideological issues involved are treated. The main issue is stressed, 'There is now a party line in Genetics—the basic scientific principle of the appeal to fact has been over-ridden by ideological considerations'. Lysenko and his followers claim that orthodox genetics, 'Mendelism-Morganism', is 'reactionary', 'clerical', 'bourgeois', 'anti-materialist'. To establish these views they quote authority—Marx, Lenin, Stalin, even Darwin—none of whom had any knowledge of the Chromosome Theory of Heredity. But is genetics clerical because Mendel was a Catholic Monk? Not all famous geneticists have been Catholics, some have even been dialectical materialists! How is it 'idealist', 'anti-materialist'? Modern genetical theory is based on the occurrence of minute self-duplicating particles of definite chemical nature, the genes. Most geneticists accept the view that the process of duplication will prove fundamentally explicable in chemical and

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physical terms, and that no supernatural or mystic powers need to be invoked to explain their behaviour. It is essentially a materialist, mechanist theory. It does not support, neither does it deny, religion. How then is it reactionary? Certainly it has been misused on occasion. Individuals with inadequate knowledge or fanatical urge have misused it to help justify racial discrimination and oppresssion. Nazism has done this on a national scale, but Huxley emphasizes that wrongful usage does not make the science itself reactionary. The writer would go further and claim that neo-Darwinism theoretically justifies a society with maximum freedom and maximum opportunity for the individual.

Chapter 3 is concerned with the scientific issue, and Chapter 4 provides an exposition of factual data on which genetic theory is based, in a readable form. Orthodox genetics is presented as a consolidated body of facts, with dependent generalizations and laws, and explanatory hypotheses and theories which endure the tests of prediction. In contrast it is claimed—and with reason—that the Lysenkoist doctrine is unsupported by any sound and verifiable observational or experimental evidence. The few experiments which have been advanced by supporters of the doctrine, or at least the few which have been made available to geneticists in other countries, have (and here Huxley quotes Darlington) "made use of the three classical precautions needed for the 'success' of experiments designed to prove the inheritance of environmental effects: namely, beginning with mixed stock, omitting the use of proper controls, and repudiating statistical tests". Moreover the results obtained in many of the 'experiments' can often be explained adequately by orthodox genetics. The paucity of experimental support, we might add, is not due to lack of opportunity; for publications on Soviet Genetics, by Lysenko himself, have been available in Australia and more readily in England. The whole doctrine is supported by appeals to authority, and by a claim (which is not substantiated) that it offers greater prospects in practice. Huxley emphasizes that neither of these bases of support is scientifically valid. Furthermore, the doctrine is protected by its presentation in a vague, ill-defined, oracular, contradictory and medieval mystic form.

What then is the conclusion to be derived from Huxley's analysis? The answer is unequivocal and direct. Admittedly neo-Mendelian neo-Darwinian Genetics is not final and complete. In some respects it provides only a first approximation; but, although all its rooms may not be furnished, it is a strongly built house on foundations of solid rock. Theories of the inheritance of environmental modifiations have cropped up repeatedly since the time of Lamarck, but that form of neo-Lamarckism which is due to Lysenko is unscientific and contrary to fact. It is utter nonsense.

The final aspect is its significance outside, or above, the purely genetical level. The conclusions to be reached are more involved, and the reasoning is more difficult. A geneticist cannot claim any special ability in its analysis, but a man of the intellectual stature of J. S. Huxley can; and in this book he succeeds in presenting a case clearly, analytically and impressively. Chapter 5 deals with 'Totalitarian Regimentation of Thought', and Chapter 6 with 'The Situation of Science'.

In order to buttress its system against internal or external enemies, imagined or real, Russia has apparently decided that it is necessary to control not only production, but also opinion. Certain schools of thought in various sciences, and in the arts, have been outlawed and others have been *established*, and have been made *official*. As Huxley rightly emphasizes, it is immaterial, in this connexion, whether the official viewpoint is right or wrong. The significant feature, which scientists certainly would find intolerable, is the restriction on freedom of thought and research.

Neo-Darwinian theory offers an instructive story of conflict in the process of evolution —the conflict of adaptation and adaptability, as developed by K. Mather. An inter-breeding population, under a given environment, may be more or less perfectly adapted to that environment. If total adaptation is high, all individuals will be closely adapted, and must be alike. There will be little variability. If variability is high, some individuals must be less well adapted than others, and the total adaptation of the population must be lower. According to neo-Darwinian selectionist theory, evolution is dependent on selection acting on variability. Little variability means low adaptability. If a species is highly adapted to a given environment, it lacks adaptability, and when the environment changes, as it will, the species may succumb. Continued evolution is dependent upon the maintenance of variability, but species may sacrifice their evolutionary future for immediate success. Such species will be dead-ends in evolution, and will die out when they cannot meet the emergencies of changing environments. Many extinct species of plants and animals have undoubtedly suffered this fate of over-adaptation.

This reasoning can be transferred to the human species, and to human social organization. Few will deny the high material efficiency of totalitarian systems, but their high materialist adaptation is obtained by the sacrifice of adaptability. They must be dead-ends, off the line of the continuing social evolution of humanity. Doubtless such systems will arise in the future, as they have in the past, wherever a community or a nation is isolated and socially inbred; but the continued social evolution of man must derive from a system permitting maximum freedom in thought and action. Perhaps orthodox genetics is 'reactionary' because it indicates the ultimate long-

range futility of totalitarian systems! It also indicates the danger inherent in the isolation of a powerful nation; whether it be for ideological reasons, or for trade advantage, and whether it be self-imposed or enforced from without.

The final chapter is one which should be brought to the notice of the political powers-that-be. The scientist is a citizen, subject to the laws of his country, and under an obligation equally with other citizens to work for the improvement of the material conditions and social organization of the whole population: but he must not be forced, nor even allowed, to subordinate his intellectual and scientific autonomy to any criteria incompatible with science. (The reader may here be referred to the article by Polanyi in This JOURNAL, *11*, 107, 1949.) He is under an obligation to discover facts, and to build up generalizations and laws, hypotheses and theories, to explain and correlate these facts. He must not confuse fact and theory, nor suppress or distort fact to fit theory. Facts may be interpretable in different ways. Opposed hypotheses may be tested by their value in prediction. A critical attitude must be retained, and heterodox scientists must not only be tolerated, they must be welcomed.

There are three postscripts. The first is of particular interest to geneticists, since reference is made to a statement by J. B. S. Haldane, a notable neo-Darwinist known to be sympathetic to the Soviet. Haldane adheres to his genetical views, and, in the main, rejects the Lysenko doctrine. He does not, apparently, comment on the other issues involved.

The book is documented by reference to reports and publications both supporting and attacking the Lysenko-ist doctrine, some of which are available in Australia. The strongest indictment of the Lysenko-ist position is provided, unintentionally, by the published *Proceedings of the Lenin Academy of Agricultural Sciences, 1948*.

News

The Royal Society

The Bakerian Lecture for 1950 will be delivered on 4 May by Professor P. W. Bridgman of the Lyman Laboratory of Physics, Harvard. The Croonian Lecture will be delivered on 15 June by Professor F. M. Burnet of the Walter and Eliza Hall Institute, Melbourne. The Ferrier Lecture will be delivered on 29 June by Professor J. Z. Young of University College, London. The first Leeuwenhoeck Lecture will be delivered on 9 November by Sir Paul Fildes. The Wilkins Lecture will be delivered on 14 December by Professor F. J. Cole of the University of Reading.

Royal Society Fellowships, 1950

B. P. Babkin (physiology, McGill), secretion by the digestive tract; conditioned reflexes.

L. F. Bates (physics, Nottingham), properties of ferromagnetic substances.

T. A. Bennet-Clark (botany, King's College, London), plant physiology; organic acid metabolism; control of water in plant cells.

B. Bleaney (physics, Oxford), microwave spectroscopy; low-temperature physics.

L. J. Comrie (director, Scientific Computing Service Ltd., London), modern methods of computation.

C. A. Coulson (theoretical physics, King's College, London), application of quantum theory to chemical problems.

L. R. Cox (geology, British Museum), invertebrate palaeontology.

H. S. M. Coxeter (mathematics, Toronto), geometry of polytopes.

G. H. Cunningham (botanist, D.S.I.R., Auckland), rust fungi; systematic mycology.

W. J. Elford (biophysicist, National Institute for Medical Research, London), methods of determining virus size.

S. B. Gates (aerodynamics, Ministry of Supply, Britain), dynamics of aircraft.

C. A. Hoare (zoology, Wellcome Laboratories of Tropical Medicine, London), parasitic protozoa, especially the trypanosomes.

L. Howarth (applied mathematics, Bristol), theory of the boundary layer; theory of isotropic turbulence; gas dynamics.

E. R. H. Jones (organic chemistry, Manchester), steroids; carotenoids; acetylene.

A. J. P. Martin (biochemistry, National Institute for Medical Research, London), liquid-liquid partition chromatographic methods of chemical analysis.

D. F. Martyn (radiophysics, C.S.I.R.O., Canberra), interpretation of radio-wave interaction; elucidation of ionospheric variations.

R. A. Morton (biochemistry, Liverpool), chemistry and biochemistry of the fat-soluble vitamins.

R. J. Pumphrey (zoology, Liverpool), sense organs and central nervous system of animals; hearing in insects and man.

A. G. Shenstone (physics, Princeton, U.S.A.; formerly Scientific Liaison Officer in London of the Canadian N.R.C.), spectroscopy.

H. E. Shortt (parasitology, London School of Hygiene and Tropical Medicine), protozoal diseases.

M. Stacey (chemistry, Birmingham), carbohydrates of animal tissue and of micro-organisms.

L. E. Sutton (physical chemistry, Oxford), electrical properties of molecules.

R. L. M. Synge (biochemistry, Rowett Research Institute, Aberdeenshire), application of the principle of partition chromatography to the separation of amino-acids and peptides.

B. P. Uvarov (entomology, Anti-Locust Research Centre, British Museum), orthoptera; international organization of measures for the control of locusts.

F. C. Williams (electrotechnics, Manchester), radar; electrical computing machines.

Nuffield Fellowships, 1950

Natural Sciences

H. A. Buchdahl, research physicist and lecturer in Physics in the University of Tasmania. Dr. Buchdahl is thirty years of age and was trained at the Imperial College, London. He will study nuclear physics or relativity theory in Great Britain.

L. H. P. Jones, agricultural chemist. Dr. Jones is twenty-seven years of age and graduated Bachelor of Agricultural Science at Melbourne in 1944. His investigations on the availability of nutrient elements in the soil will be continued in Scotland or England.

Social Sciences

J. B. Thornton, lecturer in Physical Science in the Sydney Teachers' College. Mr. Thornton is thirty-three years of age and is a graduate in Arts and Science of the University of Sydney. He proposes to study the History and Philosophy of Science at University College, London, especially in relation to the equipment of teachers of science.

Medicine

W. R. Adey, lecturer in Anatomy in the University of Adelaide. Dr. Adey is twenty-seven years of age and a graduate of Adelaide. He intends to follow research on the nervous system, especially in relation to the brain, at Oxford.

J. W. Perry, pathologist at the Children's Hospital, Melbourne. Dr. Perry is thirty-two years of age, and transferred from Queensland to graduate in Melbourne. After war service, he spent a year on the staff of the Walter and Eliza Hall Research Institute. He intends to continue his work on disorders of the liver, and on diseases of children.

V. Wynn, research worker in Physiology in the University of Melbourne. Dr. Victor Wynn is twenty-nine years of age and a graduate of Melbourne. His physiological studies are particularly concerned with the problem of water and electrolyte imbalance. He is a twin brother of Dr. Alan Wynn, who is already engaged in post-graduate medical work in London.

Humanities

A. G. L. Shaw, thirty-three years of age, who is Dean of Trinity College in the University of Melbourne. Mr. Shaw is a graduate of Melbourne and Oxford and proposes to undertake historical research upon the circumstances of some of the early convicts transported to Australia.

Special Fellowships in Extraction Metallurgy

G. M. Willis, senior lecturer in Chemical Metallurgy in the University of Melbourne, will travel to England and Europe.

Professor E. C. R. Spooner, of the chair of Metallurgy in the University of Adelaide, will visit metallurgical installations in South Africa and Rhodesia.

National University Scholarships, 1950

Physical Sciences: M. J. Buckingham, C. A. Hurst, J. R. Prescott, I. F. Wright.

Social Sciences: B. D. Cameron, A. R. Hall, H. Mulhall, R. W. Parsons, C. M. Williams.

Medicine: J. H. Bennett, G. A. Bentley, R. D. Brown, J. B. Davenport, L. F. Dodson, F. W. E. Gibson.

Pacific Studies: (Miss) A. M. McArthur, G. H. Nadel.

Professor J. B. Condliffe

Professor J. B. Condliffe, who occupies the Chair of Economics at the University of California, will visit Australia in August and September, accompanied by Mrs. Condliffe. His visit will be under the auspices of the Australian National University, with the assistance of the Carnegie Corporation. Professor Condliffe was born in Melbourne and is a graduate of Canterbury University College, N.Z., and of Cambridge. He has occupied chairs at Canterbury University College and at the London School of Economics and Political Science. He has been Associate Director of the Carnegie Endowment for International Peace, and from 1931 to 1936 was attached to the Economic Intelligence Service of the League of Nations.

National University

The position of Reader in Economic Statistics has been filled by the appointment of H. P. Brown, the Director of Research at the Commonwealth Bureau of Census and Statistics. Mr. Brown is a graduate of Melbourne, and has been a lecturer in the University of Western Australia, Investigation Officer for the Commonwealth Grants Commission and member of the Sub-Committee on National Income Statistics of the League of Nations Committee of Statistical Experts. His main field has been that of national income.

Chemical Institute Awards

The H. G. Smith Memoral Medal for 1949 has been awarded to D. P. Mellor, reader in Chemistry in the University of Sydney. The award is made by the Royal Australian Chemical Institute for the best contribution to the development of chemical science in Australia.

The Rennie Memorial Medal for 1949, which is for the best contribution by a member of the Institute under thirty years of age, was awarded to J. B. Willis, research officer of the C.S.I.R.O.

The Masson Memorial Scholarship for 1950 has been awarded to R. E. Underdown, of South Australia, who is completing the final year of the B.Sc. course at the University of Adelaide.

D. F. Martyn, F.R.S.

The Royal Society of London has elected Dr. David F. Martyn, Chief Scientific Officer of the Radio Research Board, C.S.I.R.O., as a Fellow of the Society. Dr. Martyn was born

in Scotland, graduated at the University of London, and joined the Radio Research Board in 1930. During the war he was appointed as the first Chief of the Radiophysics Laboratory, which was established primarily for research in radar. He was later seconded to the army to take charge of operational research.

Since the war Dr. Martyn has been engaged upon theoretical and practical studies in atmospheric and solar physics at the Commonwealth Solar Observatory, Mount Stromlo, especially upon tides in the upper atmosphere and upon solar physics in relation to radio propagation. In 1949 Dr. Martyn was elected by the International Union of Scientific Radio as Chairman of the Commission on Extraterrestrial Noise.

Scientific Bibliography, Indonesia

A *Postwar Scientific Bibliography*, covering the period from 15 August 1945 to 31 December 1949, has been issued as Bulletin No. 5 of the Organization for Scientific Research, Indonesia (Gambir Selatan 11 Pav., Djakarta). It contains about one thousand titles, fully classified. The titles are expressed in English.

C.S.I.R.O., Council and Executive

In place of the large Council which acted as the governing body of the C.S.I.R., the Commonwealth Scientific and Industrial Research Organization, which succeeded it in May 1949, is governed by a small Executive. The members of the Executive for the first year were Dr. I. Clunies Ross (Chairman), Dr. F. W. G. White (Chief Executive Officer), Dr. S. H. Bastow, Mr. D. A. Mountjoy (part-time) and Mr. H. J. Goodes (part-time). In March 1950 Mr. Alan Ritchie was added to the Executive. Mr. Ritchie is a pastoralist in the western district of Victoria, born in Australia, who entered the Royal Navy from Dartmouth and took an honours degree in Economics at Cambridge. He has made a significant contribution to animal husbandry in developing a strain of sheep suited to local environment, and his achievements in the complementary grazing of cattle and sheep on improved and natural pastures have aroused interest. During the 1939-45 war Mr. Ritchie was responsible for the electrical maintenance of ships in the Royal Navy taking part in the Battle of the Atlantic.

The Advisory Council of the C.S.I.R.O., as provided for in the *Science and Industry Research Act 1949*, was appointed in March 1950. It includes R. S. Andrews, A. F. Bell, F. M. Burnet, N. K. S. Brodribb, Sir Harry Brown, W. J. Dakin, A. J. Gibson, W. S. Kelly, Sir Kerr Grant, S. L. Kessell, E. H. B. Lefroy, Sir John Madsen, Sir David Rivett, E. J. Underwood, S. M. Wadham and C. Euston Young. Sir David Rivett, who was formerly Chairman of the C.S.I.R., will act as Chairman of the Advisory Council of the C.S.I.R.O.

Australian Locust Plagues

It is believed that the best hope of controlling plague locusts is to attack the insects before they reached the winged stage, when hoppers remain in the vicinity of hatching grounds for about six weeks. During this period they do not start to march for about ten days, after which swarming bands may move up to one and three-quarter miles. The rate of march depends upon the temperature, the density of hopper population, and the nature of plant cover: some bands have moved a quarter of a mile in a day, with a maximum recorded speed of five miles per hour. Methods under investigation at egg beds in New South Wales include the use of poison baits and of spraying by hand and from the air. Basic knowledge is given in Bulletin No. 245, issued by the C.S.I.R.O. in April 1950.

Sheep Branding Fluid

The expense of the extra sorting required to remove the branded portion of wool from a fleece has led to the development of a branding fluid by the C.S.I.R.O. Wool Textile laboratory at Geelong, which is removed during ordinary commercial scouring. The preparation consists of lanolin, resin, stearic acid and tallow, melted and mixed at 230° F., and then emulsified by slowly pouring into cold water with ammonium stearate and a preservative. A pigment such as monolite scarlet, or monastrol blue, or lacquer black, is then added by mixing in a ball mill.

When the branding fluid is applied to the sheep, the ammonia volatilizes. The emulsifying power of the solution is thereby lost, and the brand can then resist rain for at least a year. The hot alkaline soap solutions of commercial scouring remove it.

Survey of Foundry Sands

A survey of foundry sand resources in New South Wales has been completed by C.S.I.R.O. in conjunction with the N.S.W. Department of Mines. It covers the pits now in use and other deposits which may be worked in future. The sands available for cores for hollow castings and those used for moulds for heavy castings were found to be highly satisfactory; but sands available for medium and fine work are of poorer quality, with no intermediate grade in view. Details are reported in C.S.I.R.O. Bulletin No. 239, issued in April 1950.

Lime in Drought Feeding of Sheep

Cereal grain mixtures as used for the drought-feeding of sheep in Australia have relatively high phosphorus content and low calcium content. Young sheep fed on this diet are stunted in growth, their teeth do not form properly, and they may suffer heavy mortality. Even moderate exercise can cause grown sheep to collapse, although no outward symptoms may show when the sheep is resting. It has been found that the addition of calcium-rich foodstuffs, such as leguminous hay or chaff, or of a mineral supplement such as finely ground limestone, allows normal development to take place, restoring normal mineral meta-

bolism. Details of research under Australian conditions are given in Bulletin No. 240 of the C.S.I.R.O., issued in March 1950.

The Festival of Britain, 1951

Contributions of science to contemporary civilization will be illustrated by displays at three exhibitions in connexion with the Festival of Britain, 1951. On the south bank of the Thames, London, the practical consequences of pure science will be shown against a background of the working world of Britain; at South Kensington the emphasis will be upon the revolutions in human thought which have resulted from curiosity as to the ultimate nature of matter; in the Kelvin Hall, Glasgow, the emphasis will be upon certain branches of technology. The general aim of design has been to deal with a few selected topics adequately rather than to attempt a fragmentary treatment of all fields. Moreover, the appeal has been made by pictures and objects rather than by written explanatory material, in order to facilitate the circulation of people through the exhibitions.

The South Bank exhibition will aim to make the visitor realize how much of the accumulation of knowledge of pure science has accrued directly from the adventurousness of the British people in body and in mind. Requirements of transportation, communication and health, resulting from the far-flung nature of British enterprise, have brought contributions to knowledge from the physicist, biologist and engineer; and such initiative and venture of mind continues to be bred in Britain and the Commonwealth. The exhibition will include a Dome of Discovery, where the themes will display the extension of knowledge through earth, land and sea, to the cosmic space beyond; and our growing insight into the nature and structure of dead and living matter.

The South Kensington exhibition is designed to appeal to the 'amateur' scientist, to give him more detailed insight to atomic and nuclear structure. The method of treatment proceeds by steps from the familiar to the less familiar. The Kelvin Hall exhibition will develop the stories of the two chief sources of power used in Britain today—coal and water. These will include chapters on steel making, the use of steam, and the generation of electricity; and on the North-of-Scotland hydro-electric scheme, dock and harbour work, and irrigation schemes overseas. The culminating display will relate to atomic power.

It is anticipated that the learned societies and scientific institutions in Britain will take the opportunity of displaying an assessment of their own achievements.

University of Sydney

The establishment, staffing and equipment of the new Department of Veterinary Physiology has been proceeding over three years with funds provided by the Commonwealth Government, the Rural Bank of N.S.W., the George Aitken Pastoral Research Trust, the Australian Meat Board, and Burroughs Wellcome and Co. The grant from the Australian Wool Industry Fund to establish the Chair of Veterinary Physiology completes the foundation of the Department. Professor C. W. Emmens, the first occupant of the Chair, is thirty-six years of age and is a graduate of Wye Agricultural College, Kent, and University College, London. Both before and after the war period of 1941-1946 he was on the staff of the National Institute for Medical Research, London. His field has been sexual physiology, including its statistical aspects, and he has recently published a book on *Principles of Biological Assay.* In conjunction with workers in Western Australia and the C.S.I.R.O., he has recently initiated a research programme on the preservation of mammalian sperm and on the oestrogenic action of certain strains of subterranean clover on sheep.

Other appointments include N. W. G. McIntosh as senior lecturer in Anatomy; C. C. Renwick as senior lecturer in Economics; J. F. S. Frith as lecturer in Chemical Engineering; J. H. Tyrer as lecturer in Medicine; F. R. Whatley as senior lecturer in Biochemistry; J. A. Radcliffe as lecturer in Psychology. R. Hamilton Kenny has resigned from the position of Reader in Anatomy.

Following the retirement of Mr. Geoffrey Dale from the position of Registrar, Mr. W. H. Maze has been appointed to that position. Mr. Maze was a member of the lecturing staff in Geography from 1936 to 1947, during which time his research was chiefly upon land utilization and regional planning problems, including the possibilities of settlement in north-west Australia. For seven years he has been Secretary of the Research Committee of the University. In 1948 Mr. Maze occupied the position of Deputy Registrar, and in 1949 he visited Great Britain, U.S.A., and Canada, under grants from the Carnegie Corporation and the British Council, to study recent developments in administrative procedure in universities.

Miss Margaret Telfer has been appointed Deputy Registrar; J. D. Butchart and D. R. V. Wood have been appointed Assistant Registrars; S. Weir-Wilson has been appointed Clerk of Examinations.

Professor A. R. Todd, of the University of Cambridge, has been appointed Visiting Professor of Organic Chemistry for 1950; Professor C. K. Ingold, of University College, London, has been appointed Visiting Professor of Inorganic Chemistry. The visit of these distinguished scientists to Australia is being arranged by the N.S.W. Branch of the Royal Australian Chemical Institute.

Recent benefactions include £1000 for medical research from the National Health and Medical Research Council; X-ray plant worth £150 from K. F. Vickery for the Department of Physics; £250 from the Australian Dairy Produce Board Pasture Improvement Committee, for research

in pasture improvement; 50 guineas from A.C.F. and Shirley Fertilisers Ltd., for the Department of Chemical Engineering; £100 from Albright and Wilson (Australia) Pty. Ltd., for the Department of Chemical Engineering; £1000 from Malcolm Moore Pty. Ltd., to facilitate research in the Department of Geography upon soil erosion and regional planning; £625 from the Department of the Navy for a special research project in the Department of Chemical Engineering; £1000 from the Rural Bank of N.S.W., to assist animal husbandry and research in the diseases of sheep; £300 from the Flour Millers' Association of N.S.W., for research work by Professor W. L. Waterhouse; £1000 from the Lebanon Ladies' Association, for the provision of a scholarship or prize; £3000 from the Wool Research Trust of the C.S.I.R.O. for research in the Veterinary Physiology Laboratory; £20 from the Sydney Neurological Group towards the purchase of a Pyrox Recording Machine for research in Anatomy; £500 from the Broken Hill Association Smelters Pty. Ltd., for the Department of Chemical Engineering; alloy sections from the Australian Aluminium Co. and technical advice towards the construction of equipment for the ship model towing tanks in the Hydrodynamics Laboratory; supply at nominal price by the Department of Supply and Development of two towing dynamometers and one open-propeller dynamometer for the Hydrodynamics Laboratory; £200 as bequest from H. H. Dare, for the establishment of a prize in Civil Engineering.

University of Melbourne

Appointments to the University staff include W. E. King (lecturer in Pathology) as Stewart Scholar in Medicine; T. M. Brett as lecturer in Civil Engineering; J. A. Forbes as lecturer in Pathology; R. J. Dean as research fellow in Mechanical Engineering; D. H. Trollope as lecturer in Civil Engineering; Jean Willis as senior lecturer in Biochemistry. V. D. Hopper, who has been at Manchester with a Nuffield Research Fellowship, has resumed his duties as senior lecturer in Physics.

The W. E. J. Craig Travelling Scholarship in Animal Husbandry has been awarded to A. Mitchell, to be held at Queen's College, Belfast.

Dr. J. S. Rogers, recently Warden of the Mildura Branch and previously senior lecturer in Physics, has been appointed as Dean of Graduate Studies and Warden of Overseas Students. He will continue part-time teaching duties as lecturer in Physics to first-year medical students.

Recent benefactions include £70 from the Food Technology Association for the Department of Bacteriology; £500 from Wyvern Pty. Ltd., for a scholarship in Animal Husbandry; £250 from Shell Co. of Australia Ltd., for the establishment of a Post-Graduate Research School in Chemistry; and sums totalling £391 from three other donors.

Personal

Paul Eisenklam, a graduate of the University of Melbourne, has been appointed senior research assistant in Chemical Engineering at the Imperial College, London, after being for two years engaged on research with the British Coal Utilization Research Association at Leatherhead. P. G. Law, of the Australian National Antarctic Research Expedition, is accompanying the Norwegian-Swedish-British expedition to Queen Maud Land as Australian observer.

R. K. McPherson, senior lecturer in Physiology in the University of Queensland, has resigned to take up an appointment in Singapore, where he will continue his work upon the effects of tropical climates upon Europeans.

Professor D. M. Dunlop, who occupies the Chair of Therapeutics and Clinical Medicine in the University of Edinburgh, will visit Australia in April as Sims Commonwealth Travelling Professor, and is expected to stay for about three months.

University of Adelaide

A degree of Doctor of Philosophy has been instituted, requiring two years of research work. A degree of Bachelor of Medical Science is to be awarded to students who interrupt their medical course to complete additional work in one of the sciences in the pre-clinical years — anatomy, biochemistry, bacteriology, pathology or pharmacology.

Mr. Justice Ligertwood, Professor M. L. Mitchell, Dr. F. Ray Hone, Dr. Helen Mayo and Mr. R. A. West have been elected to the Senate.

The University has conferred the degree of Doctor of Medicine upon Lady Florey, who graduated in Medicine in Adelaide in 1924, and who was responsible for much of the pioneer clinical work on the use of penicillin in England.

University of Queensland

Following the establishment of Economics as a separate teaching chair, Associate-Professor J. K. Gifford has been appointed Professor of Economics. Professor Gifford is a graduate of the University of Glasgow, and was Deputy-Director of War Organization of Industry. V. B. D. Skerman, formerly senior lecturer in Bacteriology at Melbourne, has been appointed chief lecturer in Bacteriology. T. K. Ewer, a graduate of Sydney and Cambridge who is at present lecturer in the Institute of Animal Husbandry at Cambridge, has been appointed to the Chair of Animal Husbandry. The establishment of this Chair means that the whole of the five years of the course for the degree of Bachelor of Veterinary Science may now be taken at Brisbane.

The Senate has now held its first meeting at the St. Lucia site. The departments of Law, Mathematics, Chemistry, Geology, and part of Engineering, are soon to be transferred to St. Lucia.

University of Tasmania

Professor E. Morris Miller, who occupies the Chair of Psychology and Philosophy, has been awarded the Gold Medal of the Australian Literature Society. J. A. Cardno, who was with the British Board of Trade and Ministry of Information before coming to an appointment in Sydney in 1946, has been appointed senior lecturer in Psychology. Professor E. Kurth, the Dean of the Faculty of Science, has left for a visit to the U.S.A., under a grant from the Carnegie Corporation, to investigate methods of research in chemistry.

University of Western Australia

After two years in Cambridge with an Imperial Chemical Industries Fellowship, Dr. R. H. Stokes returned at the end of January to take up an appointment as senior lecturer in Physical Chemistry. F. Gamblen, senior lecturer in Mathematics, left for Cambridge in February on study leave. R. Storer, a graduate of the University, has returned to it as senior lecturer in Mathematics, after three years in a similar position in the University of Melbourne.

The Scientific Societies

Royal Society of New South Wales

April (annual meeting): H. Wood, Presidential address, Astronomy in Australia.
G. F. Joklik, Earth tremors of March 1949 in the Dalton-Gunning area, N.S.W.
S. E. Livingstone, R. A. Plowman and J. Sorensen, Palladium compounds of thioethers—I, The reaction of potassium chloropalladite-II with *o*-methyl mercapto benzoic acid.
G. E. Mapstone, Nitrogen in oil shale and shale oil—XII, The volumetric determination of basic nitrogen in shale oil; XIII, An approximate method for determining pyridine nitrogen in oil shale and similar materials.
R. A. Plowman, Studies in the chemistry of platinum complexes—III, Oxidation of the tetrammine-II fluorides.
W. H. Robertson, Occultations observed at Sydney Observatory during 1949.
N. C. Stevens, Geology of the Canowindra District, N.S.W. — II. The Cowra-Canowindra-Woodstock area.
H. Wood, Tables for nearly parabolic elliptic motion.
H. Wood, Tables for hyperbolic motion.
Dorothy Carroll (lecture), Methods in sedimentary petrology.

Royal Society of Queensland

March: Dorothy Hill (lecture), The earliest corals.
April: O. A. Jones (lecture), The use of seismographs for the detection of cyclones.

Royal Society of South Australia

April: C. W. Bonython, Evaporation studies using some South Australian data.

Royal Society of Tasmania

March: K. von Stieglitz, Early settlement in the northern parts of Norfolk Plains.
April: J. Bradley, The growth of mountains.

Royal Society of Victoria

Officers for 1950: President, P. Crosbie Morrison; Vice-Presidents, J. S. Turner, F. L. Stillwell; Treasurer, R. T. M. Pescott; Librarian, F. A. Cudmore; Secretary, C. M. Tattam; Councillors, E. S. Hills, L. H. Martin, O. W. Tiegs, G. W. Leeper, G. L. Wood, J. S. Rogers, D. E. Thomas, V. G. Anderson.
March: P. Crosbie Morrison (lecture), The place of ecology in the modern world.
April: M. A. Condon, The geology of the Lower Werribee River Valley, Victoria.

Royal Society of Western Australia

November: E. R. Beech (lecture), Pharmacology and nerve conduction.
C. A. Gardner (exhibit), Plants used as native remedies.
March: R. R. Forster, Western Australian Opiliones.
L. Glauert (lecture), Adaptations in reptiles and frogs.
April: P. J. Coleman, Foraminiferal investigations in the Perth Basin, W.A.
S. E. Williams (lecture), Swedish science.

British Astronomical Association, N.S.W. Branch

February: C. Trainor, Conditions for life on other planets.
Mrs. Dafter, My discovery of the Rift.

The Institute of Physics, Australian Branch, N.S.W. Division

December: R. A. Sack, Some aspects of rheology.
April: K. E. Bullen, Seismology and the interiors of terrestrial planets.
May: I. B. Thornton, Physics for fun.

Linnean Society of New South Wales

March: R. N. Robertson, Presidential address, The last haunts of demons—a comparative study of secretion and accumulation.
P. Wygodzinsky, Reduviodes from New South Wales—Notes and descriptions (Hemiptera).
Janet E. Harker, Australian Ephemeroptera—I, Taxonomy of New South Wales species and evolution of taxonomic characters.
April: Muriel C. Morris, Dilation of the foot in *Uber (Polinices) strangei*.
W. Boardman, The hair tracts in marsupials—IV.
L. D. Pryor, A hybrid eucalyptus.
K. W. Cleland, Study of the alakline phosphatase reaction in tissue sections—I and II.

The Medical Sciences Club of South Australia

April: G. M. Badger, The biological action of chemicals on cells.
May: N. Atkinson, Observations on recent bacteriological and viral work being done abroad.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

Cork from the Bark of the Paper-Barked Tea Tree

The world's cork supplies are obtained from the bark of the cork-oak, ***Quercus suber***, a

species confined, for all practical purposes, to Spain, Portugal and Algeria. The importation of cork into Australia involves dollar expenditure and local users find difficulty in obtaining all of their requirements. Many substitutes have been used in the insulation field, but the outstanding properties of cork for this and other purposes have kept up the world demand.

In 1947 a Sydney manufacturer approached the Division of Wood Technology for suggestions for a cork substitute for the insulation of his hot water heaters. Paper-bark from the broad-leaved tea-tree, *Melaleuca leucadendron* L. was suggested and a quantity was obtained from the North Coast for trial. Thermal conductivity tests were carried out by the Building Research Section of the C.S.I.R.O., using a guarded hot-plate apparatus. Loosely shredded material was used, without preliminary drying, and gave the following results*, estimated to be within 10 per cent.:

Density lb./cu.ft.	*Conductivity* B.T.U./sq.ft./hr./deg.F/in.
7·4	0·28
5·7	0·26
4·2	0·29

Microscopic examination of the paper-bark revealed the presence of a high percentage of cork cells similar in appearance to those examined in the bark of the cork oak, and it was decided to submit a sample of paper-bark flour to a well known firm of linoleum manufacturers for trial. Laboratory samples of linoleum were made using cork-oak flour and paper-bark flour. These appeared to be identical in all respects and the linoleum manufacturers have ordered half a ton of the flour for more thorough trials.

Oversize material from the manufacture of the flour is being tested by other Sydney firms for its insulating properties, and cork sheets have been successfully made in these laboratories from this material.

The Forestry Commission proposes to obtain some estimate of the amount of bark potentially available in N.S.W., and field work has commenced with the object of investigating methods of barking, rates of bark growth, stripping costs, and growth rates of the various species.

It is impossible, at this stage, to predict how much of Australia's cork requirements can be supplied from this source, but it seems probable that a basis exists for the establishment of a considerable industry.

Work is continuing in these laboratories on the processing of the bark and the properties of barks from other tea trees. It will be published in greater detail elsewhere.

L. H. Bryant.

Division of Wood Technology,
Forestry Commission of N.S.W.,
96 Harrington Street, Sydney.
21 March 1950.

* Private communication, September 1947.

A Possible Method for the Removal of Trace Elements from Solutions

An important problem that arises in the study of the trace element requirements of micro-organisms is the removal of quantities of such elements as will reduce their concentration below 10^{-9}M. One method in common use is to cause the trace element to form a complex with an appropriate chelating molecule and then to extract the complex with an immiscible solvent.

Except for one disadvantage, Erlenmeyer and Dahn's (1939) technique of 'adsorbing' metal ions on a column of solid 8-hydroxyquinoline might prove useful for the removal of trace elements. A difficulty with this technique appears to be that the material of the column itself tends to be displaced and carried down in the eluate. Meinhard (1948) has suggested that this difficulty 'could be overcome by fixing the complexing reagent irreversibly on another solid. Silica, for example, might be precipitated in the presence of 8-hydroxyquinoline to form an *oxinated* silica with the deserved characteristics'. The same object could be achieved in another way, namely, by polymerizing a metal-complex forming molecule in such a way as to leave some of its chelate ring forming groups free.

Synthetic ion-exchanging resins such as Amberlite I.R.100 have been used successfully in the removal of trace elements from solutions where they are present at a concentration of 10^{-4}M (Tiger and Gvety, 1938; Riches, 1948). The active groups in Amberlite I.R.100 are probably HSO_3, COOH and OH, the metal ions being exchanged for H^+. It is not known for certain whether bivalent metal ions, for example, are attached to these groups in pairs to form chelate rings. It is well known, however, that the stability of metal complexes is, in general, greater when they are formed from bidentate rather than unidentate groups. An improvement in the efficiency of resins for removing trace metals could be effected by devising resins with active groups so situated and of such a kind (=NOH, =NH, etc.) as to form more stable metal chelate rings than are possible with -COOH and HSO_3. It may not be feasible to polymerize 8-hydroxyquinoline itself to form a suitable ion-exchanging resin but there are possibly other organic reagents capable not only of forming very stable metal complexes but also of being suitably polymerized.

D. P. Mellor.

University of Sydney,
April 1950.

References

Erlenmeyer, H., and Dahn, H. (1939): *Helv. Chim. Acta*, 22, 1369.

Meinhard, J. E. (1948): *Science*, *110*, 389.

Riches, J. P. R. (1948): *Nature*, *158*, 96; see also *Chem. and Ind.*, 1947, 656.

Tiger, H. L., and Gvety, P. E. (1938): *U.S.P.*, 2 397, 575.

Views

The National University

The views expressed by Professor Barber in This JOURNAL, *12*, 79, make it desirable for me to comment on what is, in fact, the scope and purpose of the National University.

Professor Barber says that the University 'will contain only schools of Medicine, Physical Science, Social Science and Pacific Studies'. The *University Act*, though it contemplates the establishment of these Research Schools, gives the University Council complete freedom to move into such fields as it thinks fit. The original Research Schools have been selected because of the Council's conviction that these fields offer good opportunities for significant fundamental research. As in all such undertakings, it has been necessary to start somewhere, and I am convinced that the Council has started wisely. The fact that some fields, such as the pure humanities, have been left aside for the time being is no indication whatever that they will not be covered as the University develops.

The statement that 'the National University is set on a course which can only be described as that of applied science' is simply wrong. In the John Curtin School of Medical Research, for instance, the departments already at work are those of Biochemistry, Medical Chemistry, and Microbiology. If Professor Barber will examine the record and interests of the persons appointed to these Chairs and the work which is in fact being done in the departments, he will be compelled to the view that the University is serious in its resolve to advance knowledge at the most fundamental level. In fact, the 'hard-headed politicians' to whom Professor Barber refers have, on appropriate advice, put the University in a position to offer better facilities for basic research than have hitherto been available in Australia, or in most other places.

I feel sure that other scientists will regret Professor Barber's dismissal of the fields of Social Sciences and Pacific Studies as being 'of recent American origin but of doubtful parentage'. It is this kind of superficial stricture which tears to pieces the idea of 'education' in the broad sense in which Professor Barber professes to understand this term. The first Chair to which an appointment was made in the University's Research School of Social Sciences was that of Law. I think Professor Barber will find on enquiry that the study of law was a highly developed academic discipline long before American scholars had an opportunity to make their distinguished contributions to it. On the question of Pacific Studies, if Professor Barber takes the view that the historical, political, anthropological and geographical problems of the Pacific countries and peoples are not significant fields for scholarly enquiry, he differs from the Council, from the best academic opinion in Australia and the United Kingdom, and from myself.

I take it that Professor Barber's protest is, at any rate in part, a protest against planning in education. I hold no brief for planning as such, but I must say that I do not see how a new educational venture can be started at all unless some well-informed selection is undertaken and plans laid in advance. I think it will become clear as time goes on that these steps have, in the case of the National University, been taken literally and wisely.

I may be permitted to express some doubt whether Sir John Medley and Professor Ward would be in agreement with Professor Barber's comment or his interpretation of their contributions to the discussions on the National University at the Hobart meeting of the A.N.Z.A.A.S. Both of them happen to be members of the Interim Council of the National University and are fully aware of the limitations of the scope of activities in the University's first stage of development, as they are of its ultimate objective. I make no claim to speak for them, as Professor Barber has done, but I have not heard either of them express views that could be in any way associated with the unjustified fears entertained by Professor Barber on the contribution the Australian National University is likely to make to our academic development.

D. B. COPLAND.

Vice-Chancellor,
The Australian National University,
Canberra, A.C.T.
April 1950.

Taxonomy

During the past few years I have been receiving with increasing amazement a publication called *The Australasian Herbarium News*, published by the Systematic Botany Committee of Section M of A.N.Z.A.A.S. According to the title page it is 'a Journal for the interchange of *ideas* among the systematic botanists of Australia and New Zealand'. In the latest number (No. 5, Sept. 1949) there is an important note by Dr. Tweedie, Director of the Raffles Museum, Singapore. Dr. Tweedie deplores the chaotic state into which our museums and herbaria are falling as a result of the dearth of qualified staff to deal with the increasing weight of dead biological material. He says: 'Partly a cause and partly, perhaps, an effect of this state of affairs is the unaccountable disrepute into which purely taxonomic work has fallen in recent years'. High academic honours go to ecologists, physiologists, etc., and there is little encouragement for a brilliant student to make taxonomy his career.

Now, this is, of course, a deplorable state of affairs; but it is hardly an unaccountable state of affairs. Adequate reasons are given in the same issue of the *Herbarium News*. For example, there exists a 'Standing Committee for Urgent Taxonomic Needs of the International Botanical Congresses'. This body pro-

poses as an urgent need (and this opinion is apparently echoed by the Australasian Committee) that an *Index Herbariorum* be prepared. The Committee has in mind the 'preparation of a complete index of all known Herbaria, their location, and a list of authors, with a statement as to where their type specimens are preserved'. If taxonomy is to attract new workers, this seems to me to be one of the least urgent needs. The insistence on the inability even to start taxonomic investigations, unless one is familiar with all the specimens collected since Linnaeus's time, breeds a contempt for the experimental study of the living organism, which study rightly attracts workers to genetics, ecology or physiology.

In case there be any doubt about this point, it is demonstrated by Gardner and Johnson's learned treatise on whether *Correa* should be spelt *Correa* or *Corrcia* or whether *Grevillea* should be spelt *Grevillia*. Truly a gigantic epic of *i* versus *e*! *e* wins hands down. But it is proposed that in future *Grevillea* 'should be cited as *Grevillea* R.Br. ex Salisb. in Knight (1809) corr. R.Br. (1810)'. This seems a complete perversion of the beautiful simplicity of Linnaeus's binomial system. One is irresistably reminded of Scherf's (1949) delightful and scholarly discussion on whether *Physostegia speciosa* should be *Phystostegia speciosa* (Sweet) Sweet or just *Physostegia speciosa* Sweet. Can any taxonomist really be so dull-witted as not to realize the main reason why so few younger workers are attracted to his scholastic discipline?

There is, however, a simple answer to all these problems. It is the development of the experimental method in taxonomy. If taxonomists would give priority to experimental *proof*, over the historical study of specimens long dead, they would find geneticists, cytologists and ecologists, etc., increasingly attracted to their field of work. With our increasing knowledge of the genetic mechanisms of evolution, the matter of the experimental proof of taxonomic opinions is becoming more and more easy to carry out. Our national herbaria are fortunate in that most of them are situated in extensive botanic gardens. All that is necessary is to go out and use them.

H. N. Barber.

University of Tasmania,
November 1949.

Reference

Scherff, E. E. (1949): *Am. J. Bot.*, *36*, 1.

Reviews

Atmospheric Physics

Atmospheric Turbulence. By O. G. Sutton, F.R.S. Methuen's Monographs on Physical Subjects. (London: Methuen, 1949. 107 pp., 4 text-figs., 2 tables. $4\frac{1}{4}'' \times 6\frac{3}{4}''$.)

The concern of this monograph is exclusively with turbulence near the ground, effectively the lowest hundred metres of atmosphere. This subject stands today as one in its own right, with applications ranging from the natural phenomena of the surface, such as frost, fog, micro-climate, soil erosion, etc., to problems of modern civilization, water conservation, radar-wave travel, atmospheric pollution, and military operations.

Atmospheric diffusion, which embraces evaporation from smooth saturated surfaces, receives a chapter to itself, but other applications are not treated; space allowing only for the presentation of the subject in its fundamentals, which would-be appliers shoul acquire as background. The nature of turbulence and its analogy with molecular behaviour in gases is described in an opening chapter, followed by a mainly factual discussion of conditions in the lower atmosphere. The theoretical development is approached first through the bulk properties (eddy viscosity, conductivity, and diffusivity) of a fluid in turbulent motion, followed by a more intimate enquiry into the structure of turbulence, from which emerge the parallel mixing-length and statistical theories. The nomenclature here is unfortunate, for both are statistical and in Sutton's development both depend basically on the concept of mixing-length. The essential difference is that the process is regarded as discontinuous in one and continuous in the other. The final chapter deals, briefly and tentatively, with some of the complexities of thermally stratified flow and convection.

The subject is treated as a branch of mathematical physics. Most, though not all, of the mathematics is simple, and though at points its development appears to outrun the knowledge gained from physical measurements, this is probably a temporary phase in a young subject. The connexions with aerodynamics receive more attention than those with the wider aspects of meteorology. Indeed, the problems of the synoptic meteorologist are little eased, for air-mass formation and modification processes depend on variations with height of the upward flow of heat and moisture, and these are not discussed to any extent.

The general scientific reader, to whom this Methuen series is directed, will be aided by the adoption of a unified treatment; but this has been achieved to the exclusion of much of interest which does not conform to the set pattern, and many users will demand a broader perspective. The constant appeal to simple power laws is not always convincing. Restriction of space and diagrams is clearly a handicap, and prohibits any reference to the instrumental side. Despite these limitations the book is greatly to be welcomed as the first self-contained account of the subject in English, by an authority whose own contributions have recently been recognized by election to the Royal Society. Its timely appearance should prove a stimulus to further work which is

much needed, and provide a valuable reference for a wide range of interests. We hope soon for a fuller treatise from the same pen.

C. H. B. PRIESTLEY.

Botany

WATER IN THE PHYSIOLOGY OF PLANTS. By A. S. Crafts, H. B. Currier and C. R. Stocking. Plant Science Books, edited Frans Verdoorn, Vol. 21. (Waltham: Chronica Botanica; Melbourne: N. H. Seward, 1949. 240 pp., 56 text-figs., 49 tables. 6¾″ × 10¼″.) Price, $6.00.

A modern text of plant-water relations, emphasizing the physical and physico-chemical aspects, has been eagerly awaited. The present authors have attempted to fulfil this need and have based their book on a well-balanced plan, covering the structure of water, the properties of solutions, and osmosis. These phenomena are discussed in relation to the distribution and movement of water in plant cells. The evidence for active water movement due to metabolic energy is presented at length. Finally, the absorption, movement and loss of water from the whole plant receives attention.

The main value of this book lies in the earlier chapters, where the reader will find much on the significance of the dipole nature of the water molecule in determining the behaviour of the complex physico-chemical systems of plant cells. The treatment of osmosis follows classical lines. The final chapter on water loss is more unsatisfactory, being presented in a very confusing manner. As well, some essential principles, such as diffusion of gases through pores, are not mentioned; and certain other sections, such as the effect of physical factors on evaporation and porometry, are most inadequate. There are several statements, the meanings of which are obscure. For example, '. . . when stomata are wide open, transpiration rate depends on factors governing evaporation. Among these *the diffusion pressure deficit of water as determined by tension in the xylem and frictional resistance to rapid flow plays a major role*' (p. 197, reviewer's italics). Whatever may be meant by this statement, surely the difference in vapour pressure between transpiring surface and ambient air is most important; the degree of stomatal control will depend on the magnitude of this factor. The diffusion pressure deficit *per se* can only have a negligible effect on transpiration; indeed, diurnal variations of this quantity are determined by the rate of transpiration itself. Also, xylem tension is a resultant rather than a causal factor. Again, it is stated (p. 187) that the diurnal change in the wettability of *leaves*, as shown by Fogg, implies concurrent fluctuations in cuticular transpiration. This is not necessarily true —certainly Fogg does not think so.

In general, the completed work is very disappointing. The main principles are too often obscured by a mass of detail. This no doubt arises from the authors' attempt to produce a reference work rather than a general text; but, in these days of ample review and abstracting journals, the main need would seem to be a synthesized discursive treatment rather than a detailed card-index.

F. L. MILLTHORPE.

Chemistry

REAGENTS FOR QUALITATIVE INORGANIC ANALYSIS. International Union of Chemistry: Second Report of the International Committee on New Analytical Reactions and Reagents. (London: Elsevier, 1949. 401 pp., 60 text-figs.) English price, £1. 9*s*. 6*d*.

The First Report of the International Committee, covering the period 1910-1936, was published in 1938. It listed as completely as possible the reagents used or recommended for the qualitative detection of cations and anions. The latter portion of this period coincided with the vigorous development of the new techniques of micro qualitative analysis and 'Spot Tests', and First Report was comprehensive rather than critical. The Second Report was published in French in 1943; in this Report, now translated into English, the Committee have made a definite selection of known and tested reagents, whilst at the same time taking cognizance of new reagents developed in the period 1936-1943. The English edition is not a merely literal translation; but the text has been revised and the bibliography has been made more complete. The translation is excellent; the only serious error noted by the reviewer being the use of sodium nitride for sodium azide (pp. 283, 287).

The reagents have been divided into two groups, those for cations and those for anions. The former group has been subdivided into the hydrogen sulphide group of elements; the ammonium sulphide group, which includes the rare earths; the alkaline earth group; and the alkali metals. At the end of each subdivision the qualitative separation in outline, and the more suitable methods of detection of each element, are given. As would be anticipated, the tests for individual members of the rare earth group are scanty.

For each element, the name of the reagent is followed by the mechanism of the reaction (if known), details of the test, the sensitivity in terms defined precisely in the Technical Introduction, and finally the selectivity. For the commoner elements usually two or three reagents are described. An excellent feature of the book is the use of standard Inorganic and Organic Chemical Nomenclature.

The bibliography at the end of the book is arranged numerically and contains 1172 references that have also been classified for each element or radicle. Considering the difficulties of obtaining many journals during the years 1939-1945, it is extremely comprehensive. The book is well set up, clearly printed and well indexed. A valuable series of 57 microphotographs of the characteristic crystal forms of

many of the substances formed in the reactions is also included.

F. P. DWYER.

Chemotherapy

SELECTIVE TOXICITY AND ANTIBIOTICS. Symposia of the Society for Experimental Biology, No. 3. (Cambridge: University Press, 1949. 372 pp. 6½″ × 10″.) English price, £1. 15*s*.

Here is a book which makes a very worthwhile contribution to the literature of pharmacology and chemotherapy. It is largely a collection of papers read at a Symposium of the Society for Experimental Biology at Edinburgh in 1948.

The range of matter covered in the collection is wide and varies from fundamental discussions of physico-chemical properties, and their relation to drug action, to more specific descriptions such as the history and development of new antibiotic substances derived from *Bacillus polymyxa*.

The twenty-two separate contributions are all of a uniformly high standard and are representative of the scientific approach so rapidly taking the place of the 'routine screening research' of the late 'thirties. To single out individual contributions for special comment is particularly difficult since each is the work of a specialist in his own field, but the contribution by Professor Adrien Albert on 'Therapeutic Interference: Some Interpretations' puts forward some interesting views on the possible manner in which related foreign substances inhibit the normal curative action of a drug without any obvious chemical reaction occurring between the two. He draws attention to the possibility that a more satisfactory explanation might be based upon micelle formation than on the usual interpretations of sterically obstructed receptors upon the cell surface. Related to this work there are also the papers by Trim and Alexander on 'Surface Activity and Permeability as Factors in Drug Action', by Sexton on 'The Organic Chemist's Approach to Chemotherapy' and by Simon and Blackman on 'The Significance of Hydrogen-Ion Concentration in the Study of Toxicity'.

Of the more biological contributions, 'The Permeability of the Insect Cuticle' by J. E. Webb, and 'The Production of Antibiotics by Micro-Organisms in Relation to Biological Equilibria in Soil' by P. W. Brian, are examples of aspects of this subject which will prove of interest to the academic entomologist or botanist.

The reviewer has always regarded the criticism of the few inevitable typographical errors as superfluous, but this book is so well produced and pleasant to read that if there were any they passed unnoticed. The book should be a real help to chemists interested in the synthesis of drugs and the elucidation of their mode of action, and should find a place in any biological library.

R. H. THORP.

Heat

HEAT TRANSFER. By Max Jakob. Volume I. (New York: John Wiley; London: Chapman and Hall, 1949. 758 pp., many text-figs. 9″ × 6″.) Price, $12.00.

The author, Research Professor of Mechanical Engineering at the Illinois Institute of Technology, and known from many papers on heat transfer problems of which the bibliography of the book gives evidence, has produced a work of singular thoroughness. Ever since McAdams's *Heat Transmission* was published it has been regarded as the most careful study of that field; the book under review, however, surpasses in its approach and treatment anything that has appeared hitherto on this section of applied physics.

Heat transfer phenomena have increasingly been found to be of first importance in engineering sections which, at an earlier stage of their development, were mainly concerned with plain mechanical and thermodynamical problems. The internal combustion engine, the gas turbine and the jet engine are examples of that development. Defining the place of heat transfer in the system of sciences, the author remarks that the entry of the time factor makes heat transfer a branch of non-equilibrium thermodynamics.

The complexity of the subject is grappled with by first developing the basic equations of heat conduction, convection and radiation, and then dealing with those properties of matter significant for heat transfer. The three following parts cover heat conduction in simple bodies (ten chapters); heat convection without change of phase (seven chapters); and convection with change of phase, as boiling, evaporating and condensing (three chapters). Five appendices give problems, nomenclature —the symbols used and explained alone cover eleven pages—conversion factors, bibliography (twenty pages), and subject index.

The approach throughout is mathematical. The basic differential equations for three-dimensional investigations are explained from first principles, extending from resting to moving bodies or media, from the steady to the unsteady state, and non-periodic temperature changes. Special chapters are devoted to the analogy between heat and electrical conduction, and between fluid dynamics and heat convection, and to the various special mathematical methods applicable to heat transfer research—dynamic similarity, conformal mapping, the use of fictitious sources and images, Heaviside's operator, Laplace transformations, relaxation methods, and dimensional analysis. Special care is devoted to the various ways for developing those dimensionless moduli so essential to heat-transfer calculations.

Anyone working on heat-transfer problems knows how the vagueness of the required assumptions from which to start is one of the main obstacles to obtaining reasonably accurate results. The author does not minimize these

difficulties; how serious they are may be seen from his comment on p. 503 that not even the ratio between boundary and mean velocity of a flow can be established beyond doubt. The great value of the work is that it serves as a compendium embracing all aspects of fundamental approach to the whole field of heat conduction and convection. Thus, quite a number of dates and figures are republished from the author's earlier work after they had found their way into books of other authors, as in the chapter of bubble formation in boiling liquids.

From the limitations in content of this first volume one may guess that the second volume, now in preparation, will deal with a detailed study of radiation, experimental values over the whole field, and their bearing on the design of heat-transfer apparatus.

H. D. BRASCH.

THERMODYNAMIC CHARTS FOR COMBUSTION PROCESSES. Part I, Text; Part II, Charts. By H. C. Hottel, G. C. Williams and C. N. Satterfield. (New York: John Wiley, 1949.) Price, Part I, $2.60; Part II, $2.40.

These volumes form a valuable addition to available information about the thermodynamic properties of gaseous mixtures. The charts presented in them comprise the following:

1. A modified air chart giving the thermodynamic properties of air, all air-octane mixtures of interest, and mixtures of these with their products of combustion at all temperatures below which chemical dissociation becomes unimportant (2520°R and less). Due allowance is made for gas-law deviations.

2. Seven burned-mixture charts, mostly for various mixtures of $(CH_2)_x$ and air, at higher temperatures (up to 5500°R).

3. Generalized thermodynamic charts for all systems comprising two or more of the elements carbon, hydrogen, nitrogen and oxygen, giving values of an enthalpy function, an entropy function, and a molecular-weight function versus temperature, for each of the two pressures, 147 and 300 p.s.i.a.

The latter charts are given in Part I, and the two former groups in Part II. Part I gives full information for the use of all the charts, together with some fully worked examples.

E. J. C. RENNIE.

NUMERICAL ANALYSIS OF HEAT FLOW. By G. M. Dusinberre. (New York: McGraw-Hill, 1949. 227 pp., many text-figs. and tables. 9¼" × 6¼".) Price, $4.50.

Of the various methods of studying heat flow—full scale experiment, model size experiment, and calculation—the last will often be chosen for a first approach. Two ways are here open: to regard matter as homogeneous (as, for example, Fourier's law does), or to regard it as a finite network of points. The latter treatment is called numerical analysis. The book under review investigates heat flow by conduction, radiation and convection, mainly by that method. The first chapters bring the well-known derivations of the basic equations used in heat transfer; they are followed by the analytical treatment of multidimensional systems and geometrical square and other two-dimensional networks, for the steady state as well as for transient flow. Many problems in the relaxation method are worked out with their exact numerical values; this will be a help to the student not familiar with such procedure. The examples chosen are mainly taken from heat flow in buildings, but a number of cases taken from heat pumps and furnaces will attract the industrial engineer.

The book will be a useful help for the practising engineer. A number of interesting statements on Fourier's original work, and the assessing comments on the publications given in the bibliography, enhance its value.

H. D. BRASCH.

Physics

SURFACE TENSION AND THE SPREADING OF LIQUIDS. By R. S. Burdon. Cambridge Monographs on Physics. (Cambridge: University Press, 1949. 92 + xiv pp., 22 text-figs. 5¼" × 8½".) English price, 12s. 6d. net.

In these days of Atomic Physics it is interesting to realize how many phenomena involving surface tension—a topic to which the nineteenth century physicist devoted so much time—are still incompletely understood. The present short monograph is really a second edition, for the first appeared under the same title in the Cambridge Physical Tracts in 1940. Its aim, to quote the author's preface, is 'to enable readers not engaged in similar work rapidly to acquire an idea of the present position of the subject'. Accordingly, detailed analyses and descriptions of experimental methods have been omitted and emphasis has been placed on the newer developments.

The book is primarily devoted to fundamentals, though the last chapter briefly outlines some of the technological applications, such as lubrication, flotation of minerals, detergent action, soldering, paints, sprays, etc. After perusal of this chapter it is not difficult to see why so much of the present-day work on surface tension has passed from academic laboratories to those of industrial organizations.

The first chapter briefly describes the nature of surface forces; the second gives an account of the measurement of surface tension. In the latter the recent extension of the maximum bubble pressure method to interfacial tensions might well have been included. Mercury comes in for a good deal of attention (Chapters 3 and 5), largely on account of the remarkable disagreement about its surface tension, and on account of the intrinsic significance of metals. Chapter 4 describes the general conditions of spreading; Chapter 6 deals with spreading on

water, including some account of monomolecular films. The final chapter, 'Liquids on the Surface of Solids', covers contact angles and the technological aspects mentioned above.

Many people will read the book with interest and profit; but in view of the important topics covered, the reviewer feels that its value would have been enhanced if it had been considerably enlarged, both as regards scope and depth of treatment. The price, in relation to its content, will be a serious bar to scientists considering purchase for their own libraries.

A. E. ALEXANDER.

Polymers

A CHEMISTRY OF PLASTICS AND HIGH POLYMERS. By P. D. Ritchie. (London: Cleaver-Hume; New York: Interscience Publishers, 1949. 288 pp., 34 text-figs. 8½″ × 5½″.) English price, £1. 5*s*. net.

This is a very good little book which can be wholeheartedly recommended to chemists who wish to obtain a general view of the scientific side of natural and synthetic high-polymers. It is based on the author's post-graduate lectures at Birmingham and Leeds, and is meant to meet the need for a moderately priced single volume dealing with the organic chemistry of polymeric materials. There are already available good books on their physical chemistry and expensive monographs on various aspects of the subject. The book is written primarily for organic chemists, though physical chemistry has not been neglected in dealing with polymerization reactions. While it assumes a knowledge of chemistry at graduate level, students need not be deterred, for it is clearly written and has many well set out structural formulae.

The basic chemistry of the field of synthetic plastics is covered in chapters on the mechanism and kinetics of polymerization, addition and condensation high-polymers. Natural high-polymers are discussed in the protein, cellulose, lignin and rubber groups. In addition, there are chapters on drying oils, mineral and inorganic high-polymers, and the relation between structure and physical properties in high-polymers. The treatment is selective in that only a limited number of polymers have been described in detail; but, nevertheless, very many have been mentioned and some 200 trade names are listed in a special index. Aspects of high-polymers more closely related to their use as plastics than to their chemistry—for example, plasticizing—have been touched upon only briefly.

The book is set out very well. To avoid discontinuity in the text, liberal use is made of footnotes, which add relevant items of interest: e.g., a few biographical lines on Baekland (p. 94); notes on the sources of terephthalic acid (p. 78). Half a dozen references, mostly to books, are given at the end of each chapter; but, in the text, reference to an important point is made not by quoting a specific paper but by naming an author and year, which is sufficient clue to enable the chemist to follow any matter further.

Long names are a perpetual worry to the organic chemist and abbreviations such as P F and U F have been widely accepted, as has D.P. There must, however, be a limit to such shorthand, and Ritchie may have gone too far when he uses F for formaldehyde throughout the chapters on phenoplastics and aminoplastics. It is the more noticeable since the latter chapter refers also to U, UF, T, TF, DMU, MMU, M, MF, A, and AF. It certainly is unnecessary to abbreviate 'second order transition point' to S.O.T.P. (p. 239), when the term is used only five times in the chapter.

Mistakes are rare. The only slips noticed were very minor: omission of a methyl in formula III, p. 102; the formula for monosaccharides on p. 132. On p. 116 Smythe is credited with showing that 'the initial reaction of U with F is a slow second-order formation. . . .', whereas actually he neglected the first part of the reaction because it was so rapid, and started his measurements when almost half of the formaldehyde had combined. This may, of course, be a stricter interpretation of 'initial' than the author meant.

The field covered by *A Chemistry of Plastics and High Polymers* is wide, but it has been surveyed in a masterly way, and an excellent balance has been maintained between detail and generalization.

J. S. FITZGERALD.

Statistical Mechanics

INTRODUCTION TO STATISTICAL MECHANICS. By R. W. Gurney. International Series in Pure and Applied Physics. (New York: McGraw-Hill, 1949. 268 pp., 59 text-figs., 17 tables. 5″ × 7½″.) Price, $5.00.

'Among students of physics and chemistry there seems to be a widespread belief that statistical mechanics is necessarily a difficult and abstruse subject that cannot be presented in a form attractive to the experimentalist. In recent years several of the author's friends have challenged him to write a book to show that such a point of view is mistaken.'

One feels that the aim so stated in the author's preface has been well achieved, and that without undue sacrifice of thoroughness. Unlike the standard textbooks, this book has not been written by an applied mathematician to be readable only by his own kind or only by those to whom a highly abstract discussion with few examples of application is satisfactory.

The few results from quantum mechanics actually needed in the treatment are baldly stated (the existence of energy levels; their values in a rectangular field-free box and for rotators and oscillators; the indistinguishability of like particles; the Pauli principle). Nevertheless, the discussion is compatible with quantum-mechanical requirements from the

outset, and many applications are discussed before (in Chapter 9) classical mechanics and phase-space are introduced.

The mathematics required by the reader is limited to simple integrations. Derivation of distribution formulae is led to by considering simple numerical cases, which with the aid of diagrams, graphs and discussion make the results easy to grasp, though of course the treatment becomes the reverse of compact. An occasional summary for recapitulation and quick reference would therefore have been a useful addition.

Chapters deal with crystal lattices, including order-disorder transitions, imperfect gases, equilibrium for a partially dissociated diatomic gas, for saturated vapour and for alternative modifications of a solid. Chapter 7 deals at some length with solid solutions, with particular reference to the iron-carbon diagram. Free electrons in metals and Fermi-Dirac statistics receive very brief discussion at the end. Problems are given on each chapter.

To chemists and metallurgists and to physics students the book is likely to be valuable as an illuminating introduction to a field too often regarded as inaccessible.

R. E. B. MAKINSON.

Stochastic Processes

STOCHASTIC PROCESSES AND THEIR APPLICATION TO THE THEORY OF COSMIC RADIATION. By Niels Arley. (New York: John Wiley; London: Chapman and Hall, 1948. 240 pp., numerous text-figs. and tables. $5\frac{3}{4}'' \times 8\frac{3}{4}''$.) Price, $5.00.

This book, first printed in 1943 and reprinted in 1948, consists of two distinctly separated parts.

In the first the author describes the mathematics of stochastic processes of which the first rigorous treatment was given in 1931 by Kolmogoroff. Scientists are familiar with the statistics of variables which change by discrete amounts such as of games of chance. For practical applications in actuarial science, the theory of telephones, etc., it was found necessary to develop the theory of processes in which the probability distribution depends on one continuously varying parameter which is often time. The book progresses from a general formulation of the problem to one- and multi-dimensional processes, the treatment of which is based on the work of Feller and Lundberg during the last twelve years. In three chapters the author introduces and proves further generalizations which are necessary for the treatment of cosmic ray phenomena. The similarity of the problems of 'birth' and 'death' in cosmic rays and biology suggests that the new generalizations will also find their application in the latter subject.

Part of cosmic rays consists of showers; a primary particle impinging on the high atmosphere produces by emission of bremsstrahlung and by pair creation a considerable number of electrons, which number depends essentially on the energy of the producing particle and the thickness of the absorber. The production processes being random, this number is subject to statistical fluctuations. The study of this part of the phenomenon is the main object of the second part of the book. As the fluctuations affect considerably the results of experiments, their knowledge is essential for a comparison of experiment and of the theory of the average number of electrons. Calculations based on models which have been simplified to such an extent as to make them amenable to mathematical treatment, are pushed to the final numerical calculations of a Polya distribution. The author shows that his calculations agree with the results of experiments which lie within the limits of his model, and avoids the comparison with extensive showers for which this is not the case.

The book is not only useful for scientists working on cosmic ray research—as its title would imply—but also to all concerned with the theory and application of stochastic processes, specially to fluctation problems. In so far as cosmic ray theory is concerned, the book has stood on its own for a remarkably long time in a subject in which progress is so rapid. It is only during the last two years that the mathematics of shower production has been extended.

H. D. RATHGEBER.

Soil Science

SOILS—THEIR ORIGIN, CONSTITUTION AND CLASSIFICATION. An Introduction to Pedology. Third Edition. By G. W. Robinson. (London: Allen and Unwin, 1949.) English price, £1. 12s.

The second edition of this now standard work was last reprinted with minor corrections in 1937. In the past twelve years, in spite of the hampering of research by war conditions, there have been many advances in our knowledge of soils, and an increasing interest by the public generally in the problems of soil erosion and the maintenance of soil fertility. The book is essentially an introduction to the descriptive science of the soil; and the relationship of soils to plant growth and agriculture are dealt with in a single final chapter, which thus acts as a link with those texts in soil science which have essentially an agronomic outlook.

The first ten chapters deal with the general properties of soils: they include two chapters on soil formation, one of which emphasizes the weathering process and the second the development of the soil profile. In this latter discussion on pedogenesis, approximately equal weight is given to the influences of parent material, climate, topography and vegetation. Possibly in a future edition greater emphasis could be placed on the interactions of parent material and climate, with special reference to cycles of weathering and survival of soils from former climatic periods. Six chapters are devoted to the description of major groups of

soils, including podzols, black earths, hydromorphic soils and peats, saline and alkaline soils, soils of the tropics and soils associated with calcareous materials. It is evident from this grouping that we need much more information on soils from tropical regions; otherwise it would not have been necessary to deal with them on a regional rather than a morphological basis. The consideration of these groups leads logically to two chapters on the classification and the geography of soils. Finally, two chapters on soil surveys and the associated laboratory work complete the picture. The chapter on soil classification contains some sound advice on the general principles of classification.

Our state of knowledge concerning the mineralogy of the clay fractions of any considerable range of soils is not sufficiently advanced for this aspect to be included in soil descriptions generally, and it is evident that a new outlook on soil classification will emerge when these data are more generally available. In the meanwhile, Robinson, wherever possible, gives the silica-alumina-iron oxide ratios for the clay fractions in the characteristic profiles described. These ratios, together with content in clay and organic carbon and the *pH* values, give a background of analytical data reasonably adequate for the interpretation of the soil descriptions.

The book can confidently be recommended to all those seeking a knowledge of modern views on soil classification and an introduction to the disciplines and literature of pedology.

J. A. PRESCOTT.

Spectroscopy

SPECTROSCOPIC PROPERTIES OF URANIUM COMPOUNDS. By G. H. Dieke and A. B. F. Duncan. National Nuclear Energy Series, Division III, Volume 2. (New York: McGraw-Hill, 1949. 290 pp. 6″ × 9″.) Price, £1. 10*s*.

This book is essentially a lengthy research paper which records and explains, in an extremely lucid manner, the more prominent features of the fluorescence and absorption spectra of uranyl compounds. It includes some discussion of the spectra of nine uranium compounds which do not contain the uranyl ion.

The spectra of uranyl compounds are of particular interest, in that at liquid hydrogen temperature they show, both in absorption and in fluorescence, lines which are often as sharp as those of the iron comparison spectrum. These can be interpreted as due to electronic transitions, coupled with vibrational transitions of the lattice units such as uranyl, nitrate and acetate ions. The absorption spectra of rare earth salts also show sharp lines at low temperatures, but these spectra are much simpler, and therefore provide less information, in that there is no interaction between the electronic transitions and the vibration of the lattice units. The uranyl salts are therefore almost unique for providing detailed information of the strong interactions that can occur in the solid state, though it is possible that salts of neptunium and plutonium will be able to provide similar data.

Part I (130 pages) deals with the spectroscopic properties of uranium compounds. In this Part, the first chapter gives some account of the excellent range of spectrographs used in the investigation and of the experimental procedure for observations of fluorescence and absorption at 20°K. Chapter 2 summarizes the previous data on the crystal structure of uranyl compounds and discusses in detail the analysis of the structure of $RbUO_2(NO_3)_3$. Chapter 3 deals briefly with the modes of vibration of the uranyl ion and the duration of fluorescence. Chapters 4 and 5, which deal with the fluorescence and absorption spectra of uranyl nitrate and double salts, nitrates, chlorides, sulphates, acetates of uranyl and alkali metal ions, provide the major interest of the book. Studies of polarized fluorescence, Zeeman effect, and isotopic substitution with U^{235}, O^{18}, N^{15}, provide a wealth of interesting information and greatly facilitate the interpretation. The unexpected change in the symmetrical 'breathing' frequency of the nitrate ion in $CsUO_2(NO_3)_3$, produced by isotopic substitution of N^{15}, is of particular interest. It is to be regretted that one finds in connexions such as this that 'the data for $RbUO_2(NO_3)_3$ are omitted . . . because there was no opportunity to measure the appropriate plates'. Chapter 6 includes some intensity measurements and establishes that oxygen interchange does not occur between uranyl ion and nitrate ion even in hot, concentrated acid solutions. Chapter 7 deals with some miscellaneous observations and with the possibility of using the fluorescence spectra of uranyl compounds for determining isotopic ratios.

Part II (40 pages) is concerned with the preparation of uranium compounds, both with normal constitution and with isotopic enrichment, and with the growth of regular crystals of moderate size. The last chapter gives a brief summary of conclusions, and suggestions for further work.

Appendices include tables of wave-lengths (84 pages) and a bibliography covering the years 1919-1945. The project is incomplete in that, while spectrographic plates were obtained with 54 compounds, detailed wave-length tables are given for only 23 of these. Despite this, it is certain that the book will become a classic reference on the interpretation of the fluorescence spectra of solids and on the general spectrography of uranyl compounds.

The book is well bound and remarkably free from typographical errors; the reviewer noted only two (pp. 13, 85). The reproduction by the lithoprinting process gives the impression that the breadth of the type face has varied from page to page.

A. N. HAMBLY.

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The Australian Journal of Science

Vol. 12 | 21 June 1950 | No. 6

Concept of Nature*

L. C. BIRCH†

THESE remarks are entitled 'Concept of Nature'. Their purpose, no matter how presumptuous it may sound, is to serve as a reminder that there was once a time when the investigators of Nature were primarily concerned with discovering meaning in the world around them. It is a strange commentary on the history of science that as our knowledge of facts about the universe has expanded, our interpretation of Nature as a whole has lagged sadly behind. Indeed, an interest in this subject is almost enough to brand a person as peculiar.

Writing twenty-five years ago on philosophy and science, Joseph Needham (1925) prefaced his remarks with an apology:

> It is usually considered in this present age of specialization that the business of men is to speak only about their own affairs, and if they have any world outlook to keep it to themselves. This was not always so. In the age of Francis Bacon and Sir Thomas Browne nothing need lack their learned commentary. It is obvious enough that if the seventeenth century physician had to learn for his degree half of the physiology expected of an honours candidate today, he would have much less time than he did to think of horoscopes and theological problems.

More than one honours student in the University this year has said to the writer that these things were of great interest to him and he was looking forward to the day after his graduation when he would have time to think about them!

The Bifurcation of Nature

Although we may pride ourselves on our unwillingness to speculate beyond our own narrow field of specialization, many of the conceptions which we commonly accept as scientific and without question are little more than the speculations of a former age. But they have become built into the orthodoxy of modern science. Some of them are almost certainly wrong. One of them is the theory of the bifurcation of nature. It is still only a theory despite its common unquestioned acceptance by many scientists. It is necessary first to indicate the sense in which we are using the word 'nature'. All of us are conscious of an awareness of the world around us. Some would consider the channels of that awareness as limited to the so-called five senses. But whether we admit of five or fifty senses, awareness is an awareness of something. When we ask: what is nature?, we are asking: what is the general character of that something? The person who looks at a sunset or a flower experiences nature. There is in his object of experience both a qualitative and a quantitative component: the redness of the glow, and the electromagnetic waves by which science explains the phenomenon. But as Whitehead (1920, 1928, 1929) has insisted, we have extreme difficulty in exhibiting the perceived redness and the electromagnetic waves in one system of relations. We talk about a bifurcation—redness, and electromagnetic waves. Scientific explanations commonly leave out the one. The perceived quality, redness, is cut out of nature and made into a reaction in the mind. In so doing 'we deprive nature of half of her being'.

No one ever discovered a quality apart from a quantity nor a quantity apart from a quality. Why then are we so anxious to adopt the weird hypothesis that the quantitative is objective and real but the qualitative only subjective? If the real nature is quality and quantity together, then the classical scientific interpretation of the sunset or the flower is an abstraction from the whole. The same could be said of orthodox biological interpretations of such phenomena as the behaviour of animals, and possibly development too.

The theory of the bifurcation of nature into quantity and quality is not new. It had its roots in history, particularly in the thought of the seventeenth century which has coloured

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scientific thinking ever since. The dilemma presented itself not only as an antithesis between quality and quantity, but between mind and matter, nature and God. With Descartes in the seventeenth century the division was complete. Minds were for him forms of being outside of nature, qualities were appearances to minds and devoid of objective existence. But before considering the Cartesian position let us first look to the earliest attempts of man to interpret the world and nature scientifically.

The Greek and Semitic View of Nature

In the period 600-400 B.C. in Greece, the scientific outlook upon the world was constituted for the first time in history. That is to say, for the first time there was an attempt to interpret the universe in non-mythical terms. There was, as Farrington (1949) shows, a double tradition in Greek thought of the nature of things; a materialistic and atheistic tradition of Ionic religions and a tradition of western Greece which probably stemmed from Pythagoras. Plato described both of them in the tenth book of his Laws. It was the Platonic tradition which contributed most to a theory of nature, though Plato himself was not a scientist like his pupil Aristotle. In the opinion of Whitehead, Plato's dialogue the *Timaeus* comes nearer than any other book written before or since to providing the philosophical setting required by the ideas of modern physics. 'The *Timaeus* of Plato and the *Scholium* of Newton are', he says, 'the two statements of cosmological theory which have had the chief influence on western thought.' Farrington (1949) and Singer (1941) on the other hand regard the *Timaeus* as an aberration from a scientific point of view. Whitehead's admiration is qualified with the logical provision that:

> As a detailed scientific statement, the *Timaeus* in comparison with the *Scholium* is simply foolish. But what it lacks in superficial detail it makes up for in philosophical depth. The *Scholium* is an immensely able statement of details which though inadequate as a philosophy can be trusted for the deduction of truths. But it contains no hint of the limits of its own applications. . . . The full sweep of the modern doctrine of evolution would have confused Newton but enlightened Plato. Modern physics have reached a stage of experimental knowledge inexplicable in terms of the categories of the *Scholium*.

The world for the Greeks was never a cosmic machine made by a divine engineer who now stood apart from it except for occasional visitations. Nature was suffused with mind. Their God was right inside the world. Things had within them a capacity for the production of other things. This potentiality of the world is now generally recognized, though it is less generally conceded that goal-pursuing processes are part and parcel of the natural order. The conception of aim, goal or telos was an essential factor in the Platonic explanation.

A completely different view of nature arose in the valleys of the Nile and, later, of the Jordan. The God of the Jews transcended nature. The Jewish conception of his present manifestations was entirely different from that of the Greeks. His activity was by means of intrusions into the natural order, through violent and awe-inspiring convulsions. The storm wind, the plague and the flood were tokens of his presence. God rode on the wings of the storm. These things heralded his approach. Theologians like Manson (1948) of Manchester and philosophers such as Whitehead (1930) agree on this interpretation of Jewish thought. Although it is not scientific it is important to recognize because of the profound influence the Semitic teaching has had on western thought.

Christian Teaching

The view of the founder of Christianity, who was himself steeped in the Semitic tradition, comes closer to that of the Greeks than the Hebrews. There is no evidence that his ideas were borrowed from the Greeks, with whom he probably had no contact; the more amazing is it, then, that he should have rejected the Semitic ideas. The parable of the sower shows an appreciation of cause and effect, and also, one might add, of ecology: the relation of habitat to yield. The order in nature, that certain effects follow from certain causes, is for Jesus a cause of much wonder. It betokens a stability and a world in which a man can have confidence. The more activity the interventionist God of the Hebrews displayed, the more chaotic would his world be. The beauty of nature is also for Jesus a cause of wonder which he likens to the beauty of righteousness which clothes a human life. There is implicit in his teaching a theory of aesthetics and morals which has magnificence in its scope.

Third and Fourth Century and the Middle Ages

The third and fourth century after Christ saw a rich mixing of Greek and Christian thought in the Catechetical School in Alexandria founded by Pantaenus and famous for its two greatest leaders, Clement and his pupil Origen. These Christian Platonists, as they were called, developed what Dean Inge (Inge, 1946) and Canon Raven (Raven, 1936) consider is the noblest system of doctrine ever formulated. Their writings contain a foreshadowing of views which we tend now to regard as entirely modern. But they became the heterodoxy of the age; both Clement and Origen were branded heretics. Traditional Christianity was quick to forget its founder's teaching about nature and fell back on Hebrew ideas. St. Augustine, of the fourth and fifth century, became its authority. His rigid dualism contrasting God and the world, and the human and the divine, dominated Christian thought for 1200 years. It is still the orthodoxy of Christianity today. At the other end of the dark age for science is St. Thomas Aquinas, whose system of thought is a brilliant elaboration of the theology of Augustine and the physics of Aristotle; a physics and cosmology which were hopelessly false.

Rebirth of Science

The fifteenth century brings with it the Renaissance and the rebirth of science after a thousand years. It is a movement against Aristotelianism and the Christian cosmology. The 'new philosophy', or *Novum Organum* as its chief exponent, Francis Bacon, called it, was inspired by the astronomical and physical discoveries of Copernicus and Galileo. As a description of scientific method, Bacon's *Novum Organum*, though often quoted by non-scientists, is no longer generally acceptable as a description of the way in which a modern investigator really finds his facts. Augustus de Morgan's *On Bacon's Novum Organum*, first published in 1872 (de Morgan, 1915), and *Science, Faith and Society*, by Polanyi (1946), are valuable correctives to the ingrained Baconian definition of scientific method. Philosophical speculation on Copernican findings was left to the monk Giordano Bruno, who concluded that the universe of Copernicus was a vast machine, moved no doubt by an outsider God; in itself the world was not divine but mechanical. Bruno's cosmology survives to this day. Galileo, whose life overlapped that of Bruno, extended the conception of nature as a machine to the principle that science is measurement and only that which is measurable is real. Minds are a class outside nature and qualities are appearances to minds. This is the two-substances doctrine of nature taken over by Descartes, who gave it its completed expression. When Descartes died exactly 300 years ago, Galileo had been dead eight years and Newton was a child of seven. The idea of nature established in the Renaissance has been admirably interpreted by Collingwood (1945), whose book can be commended to the interested reader.

The Cartesian Universe

Descartes was an engineer. He constructed an engineer's universe and in his textbook of physiology an engineer's concepts of how the living body works. Harvey's great discovery of the circulation of the blood fell into his hands. Here were pumps, valves and forces directly comparable with the workings of machines. In a generous tribute to Descartes on the present tri-centenary of his death, the historian of science Dingle (1950) writes:

> It is very questionable whether the great advances of those two centuries following Descartes could have been possible without the simple concrete picture of a passive extended universe of matter presented for study to independent minds. There was much to be done that could be effectively conceived in those terms and the acceptance of an over-confident materialism was perhaps not too high a price to pay for the discussions and correlations that would have been achieved, if at all, only with much more difficulty, less general understanding, and far less speed. It was not until almost our own time that the Cartesian doctrine began to mislead . . . Physics today is in a transition stage in which many of its devotees, rather than abandon the Cartesian universe, are prepared to make it nonsense by giving it contradictory properties . . . It is perhaps a melancholy thought that we can best celebrate the death of Descartes by expediting the death of his system.

The mainstream of thought flows directly from Descartes to Newton. He held the Semitic theory of the divided universe. His *Scholium* describes a mechanical universe with God as an outside mover transcendent to it. Two of Newton's contemporaries on the Continent were reaching a very different point of view on nature. For Spinoza, mind and matter

were two attributes of one substance which he variously called God and nature. Leibnitz, who independently discovered the calculus about the same time as Newton, says that nature is not a machine but a vast organism whose parts are lesser organisms. Both these philosophers reflect back to the Greek tradition with its immanence of mind in matter. In England, John Locke came close, in his *Essay on Human Understanding*, to formulating an organic philosophy of nature, but he still kept too close company with the dualism of Descartes. Despite the attempts of these three philosophers, the seventeenth century leaves us with the relationship between mind and matter, quality and quantity, still unsolved.

A solution was attempted by Berkeley in the eighteenth century. If one element of nature, namely qualities, is a product of minds, why not nature as a whole? For Berkeley it was the product of the mind of God; for Kant and Fichte, the mind of man. A bright wit of the period summed up the argument in the phrase, 'No matter, never mind!'. The Berkeleyan philosophy was even less satisfying than the Cartesian division and with a few exceptions (e.g., Morgan, 1905) has not commended itself to scientists.

Breakdown of the Cartesian System

Newtonian philosophy exhausted itself in the classical physics of the nineteenth century with its concept of discrete atoms and empty space so foreign to the modern physicist. Physics had to await an entirely new advance in the discoveries of Rutherford and Einstein with their tremendous implications for an organic view of the universe. They desert the mechanistic interpretation of classical physics and replace the discrete static atom with an organism characterized by ceaseless activity. There is no such thing as an atom at an instant. Matter is process, it is very much alive, and process takes time. 'The electron is what it does'; spacial concepts alone are inapplicable. We might now ask, where do mind and quality fit into this picture? That is a question the attempted answer to which has been the life work of A. N. Whitehead, philosopher-scientist of Harvard. His theory of organism, which is a thoroughgoing refutation of the Cartesian universe, rests not only on a knowledge of modern physics, but on biology and other sciences too. We shall therefore leave him at this point to return again after having considered briefly the particular contribution of the rise of biology to the problem of the divided universe.

The knowledge of physics was so vastly in advance of biology in the seventeenth century that mechanistic interpretations of living activities were almost inevitable. The circulation of the blood and the digestion of food were interpreted in terms of simple mechanics. The eighteenth and nineteenth century biologists provided little alternative save the ill-defined notions carried over from vitalists like John Hunter and Stahl. There is consequently a marked similarity between the physics and biology of the time. Physics had its fixed ultimate entity—the atom. As far as it had a metaphysic it revealed the world as a machine created by a God transcendent to it. Biology was not so different with its concept of the fixity of its entity, the species. 'There are as many species', said Linnaeus, 'as the different forms which the infinite being created in the beginning.' The biologists also had their designer God related to the world in much the same way as a carpenter to the table he has made. The English biologists in the eighteenth and nineteenth century looked to the adaptations of nature for evidence of God's design and goodness. This was a movement which reached its unsteady zenith in Paley's *Natural Theology* and the *Bridgewater Treatises* of 1833. The authors of these works were deists, but they believed in a thoroughly mechanistic universe which got on well enough without their God. With a few notable exceptions (e.g., Wood-Jones, 1942), modern biologists reject the simple arguments of the *Bridgewater Treatises*. Mere utility and adaptiveness does not necessarily imply purpose. The design of nature and its adaptations were to receive quite another interpretation in Darwin's brilliant theory of evolution published in 1859. The theory struck a death blow at two key points: the fixity of species and the argument of purpose from design. Natural selection of chance variations was postulated to account for the adaptation of plant and animal life. The insistence on chance variations struck at the element of purpose and therefore the deity of Paley and the *Bridgewater Treatises*: the God of the seventeenth, eighteenth and nineteenth centuries. Two alternatives were left. Either the concept of

purpose, mind and God were completely irrelevant to biology and living activities were to be interpreted solely in mechanistic terms; or alternatively, if purpose, mind and God were relevant terms, a new meaning had to be attached to them. The first choice gave us the materialistic biology of the late nineteenth and twentieth century. Despite the unconvincing nature of Jaques Loeb's interpretations of behaviour and development at this period (Loeb, 1912), most biologists were loth to move far from his mechanistic position. There were good and bad reasons for this. The alternatives to mechanism were even less convincing; the seventeenth century vitalists had not been succeeded by anything outstandingly better. The popularity of mechanism was also due to the success of mechanism itself as an assumption in experimental biology. The experimenter who regarded animals as machines could get a long way even though mechanism might be inadequate as a complete interpretation. Furthermore, the machine age had coloured all man's thinking and, when precise description broke down and imagery had to be used, he took the nearest thing at hand as his metaphor and that was a machine. The mechanical analogies of Loeb and his followers were about as crude as the vitalists' arguments of the same period. Not until the last few years has a theory of mechanism been evolved which in any sense attempts to fit the twentieth-century scene. It is the theory of *Cybernetics*, a word derived from the Greek word meaning 'steersman' (Wiener, 1948). It attempts to interpret processes which appear to be purposive, or guided by goals, in non-purposive terms (Rosenbleuth, Wiener and Bigelow, 1943). The mechanical models which are the inspiration of this school are the supreme mechanical inventions of the twentieth century —the modern calculating machine and the guided missile. In its imagery it has graduated from the pump and the steam engine to the most complex inventions of man. The all-embracing generalizations of the Cybernetics school are reminiscent of the generalizations of the *Bridgewater Treatises*. We may well pause to query whether this new philosophy is the complete explanation of all that it seems to claim for itself. Cybernetics is not the only successor to the old mechanical materialism. The influence of Marx and Engel's doctrine of dialectical materialism on science is comparable, perhaps, with its influence on the structure of society. Opposed to both vitalism and mechanism, it has some affinities with the organic view of the world, at least in its emphasis on the transformations in evolution which give rise to the qualitatively new. Some of its proponents (e.g., Needham, 1944) would claim it as the synthesis of the two contrasting streams of thought; the organic and the mechanistic interpretation of nature.

Rise of the Theory of Organism

Parallel to the rise of mechanism culminating in the theories of Cybernetics and dialectical materialism of our own day, is the development of an organic view of nature, a view which stems from fourth- and fifth-century B.C. Greece rather than from Descartes. We have already seen its re-emergence in the Christian Platonists and then much later on the Continent in the works of Leibnitz, Spinoza and Goethe. The really significant developments had, however, to await the rise of modern physics and biology. Although Darwinism gave rise to an upsurge of mechanism, not all post-Darwinian biologists were mechanists. The embryological studies of Rough and Driesch and the studies of instinctive behaviour in insects by Fabre inspired biologists like J. S. Haldane (1936) and philosophers like Bergson to find mind and purpose no longer transcendent to the world but immanent in it. Some of their concepts were crude, and words like 'vital force' and 'entelechy' did not help their cause. The vitalists had one thing in common: their conviction that the activities of living organisms (and possibly non-living ones too) could not be fully understood without the concept of goalseeking—even at the unconscious level. These early attempts at explanation failed because they posed an either/or instead of a both/and position. There is now, however, a little-known but eminently worthwhile group of biologists who, finding mechanism inadequate, especially in the interpretation of instinctive behaviour and development, have taken this latter path. One might mention Agar (1938, 1943) in Australia, Lillie (1940, 1942) and Gerard (1940) in Chicago, and amongst the philosophers Hocking (1944) of Harvard. All these authors acknowledge their indebtedness to A. N. Whitehead's philosophy of organism. Since Whitehead is essentially in the Platonic tradition, this school of biologists

carries us full-circle back to Plato with his concept of nature suffused through and through with mind and purpose.

Implicit in Whitehead's philosophy is the proposition that if both matter and mind exist they exist together to the most elementary level of organization; and that, so far as we know, is the electron type of entity. The meaning of the concepts, mind and purpose, at the electronic level is an aspect of his philosophy which is one of the most difficult to conceive. It is easier to start at the other end, at conscious purposive activity in man; to trace through purposive activity to the unconscious level in living organisms, and then see it in principle at the inorganic level. The peculiar property of nature which Whitehead sees at every level of organization is the nisus for the production of things, the lure for the completion of a process both in the living and non-living organism. The theory of organism would seem to imply a transition from non-living to living without sharp dividing lines. The infinite lure for all processes Whitehead sums up in his conception of God. His is a God very different from that of Newton or the *Bridgewater Treatises*. To those who know something of the sweep and magnificence of Whitehead's thought there is a compulsion to follow further where his thought leads. It is the most thoroughgoing attempt to think of the universe as a universe and not a diverse.

Today we are faced with a division in thought and understanding of nature given to us by history. The Cartesian universe, which is still the conception implicit if not expressed in the thought of many scientists, is losing ground. The thoroughgoing mechanism of Cybernetics is taking its place to some extent. Dialectical materialism is the creed of Soviet science. The theory of organism challenges them all, but remains little understood and little appreciated. It does matter what we think about these things; the French Revolution has been traced by some back to Descartes' influence on followers like Voltaire. It is a thesis that could be defended that the interpreters of Darwin, who carried over the notion of struggle for existence and survival of the fittest to human society, had a profound influence on broadcasting ideas amongst the uncritical masses, which seeds developed into the first world war. When we reflect on the impact which the thought of science has had on society in the past, it behoves us to think responsibly and soberly on these things at this critical period of world history.

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Chemical Constitution and Biological Action

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FEW subjects are as fascinating as the study of the relationship between chemical constitution and biological action. It is, of course, a very wide subject, embracing as it does the

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study of inorganic salts as well as a host of organic compounds such as the vitamins, hormones, the antimicrobials of all kinds, the symptomatic drugs, the insecticides, and all the other classes of biologically active substances. As a borderline science it can be conducted only by suitable collaboration between physiologists, pathologists, pharmacologists and clinicians, and physicists, chemists and biochemists. This article is chiefly concerned with the part which chemists play in the investigation.

To the chemist, one of the chief difficulties of the study is in the interpretation of the biological results; for the biological assay of drugs is by no means an exact science. In a group of, say, twenty or thirty mice it is not unusual to find an individual to which a given chemical or drug is five times more toxic than it is to another, and a dose which proves fatal to one individual may leave another completely unaffected. The variations sometimes found among animals of the same strain and sex are often profound. For example, Barger and Dale (1910), in their classical experiments on the activity of the compounds related to adrenaline, tested two very closely related compounds —one a primary amine and the other a secondary amine—on three cats. Two of the cats, quite regularly, showed a larger rise in blood pressure with the primary amine, while the other, equally regularly, gave a larger rise with the secondary amine. The type of animal used may also affect the results to a marked extent, and one cannot calculate the toxicity of a drug for one species from experiments in another. This is illustrated by the fact that the toxicity of atropine to man is 500 to 1000 times that which it is to mice. Moreover, apart altogether from species differences and the normal range of variation, certain individuals may react to a drug in a wholly abnormal manner. In some individuals aspirin produces extensive eruptions, and idiosyncracy is often observed to iodine, to quinine, and to many other common chemicals.

A second complicating factor in the study of the action of chemicals on cells is that the requirements for a given biological action may not necessarily be the same as the factors governing the ability of the drug to reach the site of action, and it is for this reason that the *in vitro* activity of drugs does not always parallel their *in vivo* activity.

Generally speaking, the first requirement for biological activity is that the drug should be soluble in the fluids of the body. Insoluble substances, such as barium sulphate, are pharmacologically inert; while closely related substances, such as barium chloride, are active. This, however, is by no means the only requirement. Some drugs fail to give the expected results in biological experiments owing to prior absorption by tissues, or by the blood corpuscles or other constituents of the blood, before reaching the site of action. It is for this reason that many antiseptics show reduced activity in the presence of serum. Some drugs are able to reach the site of action only when given intravenously, others when given by mouth. Curare, the South American arrow poison, is an excellent example of such difference. This substance is very poisonous when given by injection, but practically harmless when given by mouth. In the latter case, absorption of the drug into the blood stream proceeds only very slowly and a toxic concentration in the blood is not formed. This is shown by the fact that the South American Indians are able, in perfect safety, to eat game killed with poisoned arrows.

Drugs may also suffer metabolic change or even extensive decomposition by enzymes before reaching the site of action, and it is noteworthy that minor structural changes in a molecule, changes which have very little effect on the ultimate biological action, may profoundly affect the rate of decomposition, or even the mode of decomposition, by enzymes. Certain pressor substances, such as adrenaline, although very potent when administered intravenously, are inactive when given by mouth. Other closely related substances, having an additional methyl group in the side chain, are not attacked by amine oxidase, and are active both by injection and when administered by mouth. Ephedrine is also an example of the second class (Beyer and Morrison, 1945).

Examples of the metabolic inactivation of potentially active drugs are, of course, relatively common, and some examples of metabolic activation are also known. One of the best known is the metabolic reduction of 'Prontosil', which is active only *in vivo*, to sulphanilamide, which is active both *in vivo* and *in vitro* (Tréfouël, *et al*., 1935). Similarly, arsenicals such as 'Atoxyl' in which the arsenic is pentavalent, are potent trypanocides *in vivo*, but inactive, or only slightly active, *in vitro*. All the evidence points to the fact that 'Atoxyl', and other derivatives in which pentavalent arsenic is present, are reduced in the animal body to compounds containing trivalent arsenic. Chemical reduction of 'Atoxyl' gives *p*-aminophenylarsenious oxide and diaminoarsenobenzene. Compounds of this nature are not only more active trypanocides than the atoxyl type of compound, but are also active both *in vivo* and *in vitro*.

Another problem which is especially important in trypanosomiasis concerns the inability of certain drugs to reach the brain. Drugs such as 'Antrypol' (Bayer 205) and 'Trypan Blue' are effective in the first stage of the disease when the infection is practically limited to the blood and lymphatic system. In the nervous stage, however, when some of the trypanosomes have invaded the brain, these drugs are ineffective as they are unable to pass the so-called blood-brain barrier (Lourie, 1943).

The nature of the carrier medium for a drug may profoundly affect its activity. Most frequently the carrier medium is water, or at

least an aqueous solution containing various salts, proteins, etc. The most important variant is pH, which may influence the drug itself or the tissue component upon which the drug acts. The sulphonamides, for example, are mostly monobasic acids, and the activity varies considerably with the pH of the medium. The ionized form of the drug is more active than the molecular form, and the fraction ionized depends both on the acid strength of the particular sulphonamide and the pH of the medium (Bell and Roblin, 1942). The more strongly acidic sulphonamides are almost completely ionized at pH 7, but the weaker acids are almost entirely in the molecular form at this pH. Again, the pH of the medium affects the solubility both of the free drugs and of their acetyl derivatives, in which form most of the sulphonamides are excreted in the urine. These compounds are more soluble in neutral or in alkaline media than in acid media, and as urine is more acid than blood plasma there is a tendency for the acetyl derivatives to crystallize out (Krebs and Speakman, 1945). Another important example of the effect of pH on the biological activity is to be found in the acridine antiseptics (Browning, Gulbransen and Kennaway, 1919; Albert *et al.*, 1945).

Modes of Drug Action

Of all the problems associated with the study of the relationship between chemical constitution and biological action, none is more obscure than the mode of action. The common laxatives, for example, are known to be of four main types:

(1) Liquid paraffin. This acts as a lubricant and softens the faeces.
(2) Certain inorganic salts. These act by increasing the water content of the intestine. All soluble salts of magnesium act in this manner, and so do certain salts of sodium, such as the sulphate, phosphate and tartrate.
(3) Cellulose and agar agar. These act by increasing the bulk of material in the intestines.
(4) Irritant purgatives. These act by irritating the mucosa of the gut, causing increased peristalsis. In this class are castor oil, sulphur, hydroxyanthraquinones, phenolphthalein, mercurials, etc.

There is no chemical relationship between these various types of laxative, and it is not surprising that liquid paraffin acts by a different mechanism from that of magnesium sulphate. On the other hand, there are also many known (and probably very many more unknown) cases where drugs of similar chemical structure bring about the same biological end-result by different mechanisms. It has been suggested, for example, that the sulphonamides produce their specific antibacterial action by interfering with the utilization of *p*-aminobenzoic acid as a growth factor. The structural dimensions of sulphanilamide are very similar to those of *p*-aminobenzoic acid, and a competitative interference of the nature envisaged by Woods and Fildes would, at least, seem to be feasible; for *p*-aminobenzoic acid is very effective in antagonizing the antibacterial action of the sulphonamides (Woods, 1940; Fildes, 1940a). The very closely related homosulphanilamides, such as sulphabenzamide ('Marfanil') are not antagonized by *p*-aminobenzoic acid, and they apparently act by a different mechanism.

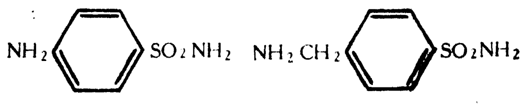


Figure 1.

In attempting to explain the mode of action of drugs, particularly of the chemotherapeutic substances, Ehrlich introduced the concept of receptors. These receptors were thought to be certain specific component parts of the cell which have the property of combining with certain chemical groups or radicals. Ehrlich found it necessary to postulate the existence of a large number of such receptors, and he also distinguished between the receptors governing the 'fixation' of the drug and those conditioning biological activity. In this way any alteration in the substituent or 'fixing' groups of a drug may affect its site of action (Ehrlich, 1913; Ing, 1943).

Dyestuffs have played a large part in the development of the theory of receptors, for, as is well known, it is often possible to achieve selective staining of some tissues but not of others, in just the same way as dyestuffs sometimes have affinity for one type of fibre but not for another. The fact that the drug combines with, or is adsorbed by, the cell does not necessarily mean that it will exert a biological action, but it does appear to be a reasonable prerequisite. It is of interest in this connexion that malarial parasites and trypanosomes both take up the three acridine compounds, 'Atebrin', 'Trypaflavin' and 'Rivanol'. 'Atebrin', however, kills only the malarial parasites, 'Trypaflavin' only the trypanosomes, and 'Rivanol' is without biological action on either (Fischl and Singer, 1935).

It is true that the receptor theory does very little more than provide a mental picture of the observed facts, for it provides no clue to the biological activity of the drug-receptor combination. Nevertheless, the theory has proved a great stimulus to research. Moreover, the existence of some type of receptor—not perhaps as Ehrlich visualized them—does appear to be necessary; for many drugs are active at a concentration far less than that required to form a monomolecular layer on the cell surface.

On the other hand, specific cellular receptors have been identified in only a few cases. The atom of iron in hæmoglobin is certainly the

receptor for the oxygen in ordinary respiration, and the biological activity of many of the heavy metals and non-metals is almost certainly due to the fact that they combine with, and inactivate, the –SH groups in an enzyme. The action of mercury on bacteria can be reversed by treating the bacteria with hydrogen sulphide, or with various thio-compounds (Fildes, 1940b).

A recent application of this idea is found in the theory of the mode of action of the war gas 'Lewisite' and of 'British Anti-Lewisite' (BAL). 'Lewisite' is supposed to combine with the –SH groups in an enzyme to form a cyclic compound having about 8 to 14 atoms in the ring. In view of its size this ring system must be relatively unstable, so that if a sulphur compound which is capable of forming a more stable ring system with 'Lewisite' is added, a steady transfer of the 'Lewisite' from the enzyme to the added thio- compound might be expected. BAL forms a five-membered ring system with 'Lewisite' which is apparently more stable than that formed between the enzyme and 'Lewisite', so that the gradual transfer of the arsenical from the enzyme to the BAL does occur. In this way the 'Lewisite' is deactivated and excreted. According to Graham and Hood (1948), BAL is an effective antidote to poisoning by arsenic, mercury, antimony, chromium, nickel and cadmium.

With all the complications inherent in biological systems, and knowing our ignorance of all but the most elementary facts regarding modes of drug action, it is perhaps surprising that there is ever any relationship between chemical constitution and biological action. It must be admitted at once that the correlations which have been observed are all too few, and that even these are apt to break down if extended too far. Nevertheless, it is profitable to discuss the validity of such correlations, more especially as, once observed, these relationships may assist in the introduction of new drugs of value to the clinician.

The Influence of Physical Properties

Certain biological actions are structurally specific in that they are produced only by chemicals of one specific type. Others appear to be largely, or entirely, non-specific. It has long been known, for example, that the narcotics are of very diverse chemical nature, and it is quite impossible to discern any relationship between chemical constitution and narcotic activity. On the other hand, the activity of these compounds as narcotics may often be correlated with some quite simple physical properties such as water solubility, oil/water distribution coefficients, vapour pressure, surface activity, and so on (Richet, 1893; Overton, 1901; Winterstein, 1926; Meyer and Hemmi, 1935). All these properties are measures of the relative distribution of the drug between heterogeneous phases. Solubility is a measure of the distribution between a solid (or liquid) and its saturated solution. Surface activity is a measure of the distribution of the substance between the surface layer and the main bulk of the solution. Vapour pressure is a measure of the distribution between a pure solid (or liquid) and its vapour, and so on (Ferguson, 1939). As these physical properties indicate the way in which a given substance distributes itself between heterogeneous phases, they may be used as measures of its tendency to 'accumulate' in any one phase. The fact that correlations between such physical properties and narcotic activity can be observed is evidence that they act by some physical mechanism, probably by accumulating at some vitally important part of the cell and inhibiting certain respiratory processes (Albert, 1950).

Very many different types of chemical compound may act in this way. They may be hydrocarbons, chlorinated compounds, alcohols, ethers, ketones, aldehydes, amides, cyclic amides, and so on. These compounds are all hypnotics or, when sufficiently volatile, general anaesthetics. They also produce a host of other biological actions ranging from the haemolysis of blood, and the inhibition of development of sea-urchin eggs, to bactericidal and insecticidal activity.

The study of the biological activity of compounds in homologous series is of very great value in assessing the influence of physical properties. It has long been known for many biological actions that as one ascends an homologous series the equi-effective concentrations decrease very rapidly. Indeed, this generalization is known as Richardson's rule. It is

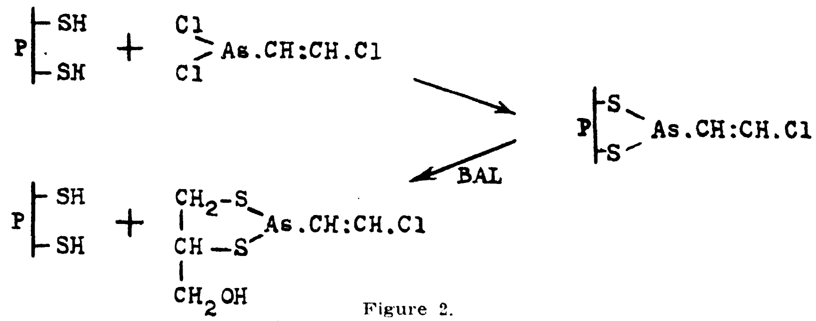


Figure 2.

important to note, however, that this decrease in equi-effective concentration is a quantitative one: each member of the series is about three times as effective as its immediate predecessor; or alternatively, each member exerts the same biological action as its immediate predecessor when it is present in only one-third the molar concentration. In other words, the biological activity of compounds in an homologous series increases in geometric progression as the number of carbon atoms increases in arithmetic progression. As the magnitude of such physical properties as surface activity, oil/water distribution coefficients, and the like, also change in geometric progression as the series is ascended, the parallelism between activity and such physical properties is marked (Ferguson, 1939).

Examples of the quantitative decrease in equi-effective concentration as the number of carbon atoms increases are numerous: the narcotic activity of alcohols, alkyl acetates and ketones on tadpoles; the bactericidal action of alcohols, ketones, amines and alkylphenols; the haemolysis of blood by urethanes, alcohols, esters and ketones; the toxicity of alcohols towards insects; the narcotic activity of paraffin hydrocarbons on mice; the toxicity of alcohols and esters to potato tubers; the inhibition of development of sea-urchin eggs by alcohols; the narcotic activity of alcohols on frog's heart and tortoise heart; and in other cases.

Ferguson has suggested that instead of using concentrations when comparing the relative biological activities of compounds, the thermodynamic activity should be used. When this is done it is found that, as an homologous series is ascended and the equi-effective concentration progressively decreases, the thermodynamic activity slowly increases. This means that although a rapidly diminishing concentration suffices to produce a given biological effect, a slowly increasing thermodynamic activity is needed. As, by definition, the thermodynamic activity cannot exceed unity (which occurs when the solution becomes saturated), the member of the homologous series for which the thermodynamic activity approaches unity possesses maximum biological activity. After that member the 'cut-off' occurs, for a more than saturated solution would be needed to produce a given effect. The position of the 'cut-off' in any series depends on the resistance of the organism to the drug or toxic agent; very resistant organisms cause the 'cut-off' to appear early in the series. In some cases it is possible to predict the position of the 'cut-off' from the results obtained for the lower members of a series, for the logarithm of the thermodynamic activity appears to increase by a constant amount for every additional methylene group (Badger, 1946).

The Influence of the Chemical Nature

Although the physical properties of the compounds appear to be of pre-eminent importance for narcotic activity, and for certain somewhat similar biological actions, this is not true for many other types of activity. In other cases the activity of the compound is determined by the number, position, and nature of its chemical groups. The association of the activity of BAL with its thiol groups and the fact that such groups readily combine with certain heavy elements such as arsenic, has already been mentioned, and the actions of most of the organo-metallic drugs — salvarsan, stovarsol, tryparsamide, etc.—are probably almost wholly dependent upon the chemical properties of the arsenic or other heavy element present.

Most of the antiseptics also owe their activity to their chemical nature. In general, there are two types: anionic antiseptics and cationic antiseptics. The anionic antiseptics are the neutral or faintly alkaline salts of acids of high molecular weight, such as common soap and the 'acid dyes'. These salts probably act by attacking amino groups or bacterial proteins. The cationic antiseptics, on the other hand, are neutral salts of bases of high molecular weight, such as the aminoacridines (including acriflavine and proflavine) and 'basic dyes' such as gentian violet. This type of antiseptic probably acts by reaction with the acid groups of bacterial proteins (Albert, 1942).

That the chemical nature of drugs may have a profound effect on the biological action was clearly demonstrated by the pioneer work of Crum Brown and Fraser (1869). These two workers studied the change in biological action produced by the methylation of a number of alkaloids, including strychnine, brucine, atropine, codeine, morphine and thebaine. On conversion into the quaternary salts, all these alkaloids were found to lose most or the whole of their original activity and to acquire instead the power of paralysing motor nerve endings, similar to that produced by curare. It is of some interest that this change in biological action was of little more than theoretical interest until quite recently, when curare was introduced for the induction of complete surgical relaxation.

The preliminary work of Crum Brown and Fraser indicated that the onium ion is of prime importance for curariform activity, although some other types of compound exhibiting the same or similar types of activity, have since been discovered. It is now known that quaternary ammonium, sulphonium, phosphonium, arsonium and stibonium salts all possess curariform activity. The order of decreasing activity is: $(CH_3)_4N^+ > (CH_3)_3S^+ > (CH_3)_4P^+ > (CH_3)_4As^+ > (CH_3)_4Sb^+$, and the ions of potassium, sodium, and other alkali metals, as well as the ammonium ion, have also been shown to possess some activity (Craig, 1948).

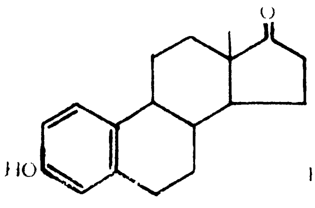
The Influence of Molecular Architecture

In some cases it seems that a particular biological action is initiated only by compounds

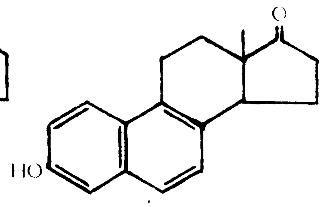
the molecules of which have a certain specific shape and size; and although exceptions to correlations of this kind are numerous, it must be admitted that hypotheses of this nature have proved of very great value in the development of new and more satisfactory medicinals.

Possibly the best known examples of this concept are to be found among the sex hormones. Nearly all the oestrogenic compounds are dihydroxy- or keto-hydroxy- compounds, and it seems likely that maximum activity is achieved only when there is an optimum distance between the pharmacodynamic groups. In a general way Schueler (1946) has shown this to be the case for a series of oestrogens, and moreover, crystallographic studies have revealed that oestrone and the synthetic hormone, stilboestrol, are molecules of identical length, namely 8·55Å (Giacomello and Bianchi, 1941). It seems that a given substance may be oestrogenic if it has a rather large structure with two groups capable of hydrogen bond formation (e.g., phenolic hydroxyls) set a certain distance apart. Very many oestrogens are known which conform to this rule, and the variations in chemical type and structure apart from these requirements may be considerable. It must be admitted, however, that several oestrogens are known which do *not* conform to this rule.

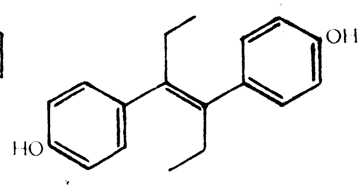
The influence of the molecular architecture may also be assessed by a study of stereoisomers. Hexoestrol, one of the most potent oestrogens, is *meso*-dihydrostilboestrol. The isomeric substance, *iso*hexoestrol or *dl*-dihydrostilboestrol is very much less active. These differences in biological activity are of special interest as the compounds differ only in the configurations of the two carbon atoms joining the two benzene rings. Moreover, Carlisle and Crowfoot (1941) have made an X-ray crystallographic study of these compounds in comparison with that of oestrone and have concluded that the stereochemical arrangement of the *meso* compound is very closely related to that of oestrone. The influence of stereochemical configuration is also shown by the fact that *d*- and *l*-*iso*equilenin are inactive, but *d*- and *l*-equilinen are active (Bachman *et al.*, 1940). In the former the junction between the C/D rings is probably *cis*, and in the latter probably *trans*. Similarly, the doisynolic acids and bisdehydroisynolic acids show very great variations in activity with stereochemical configuration (Miescher, 1948).



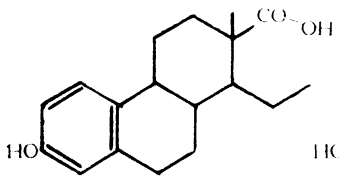
oestrone



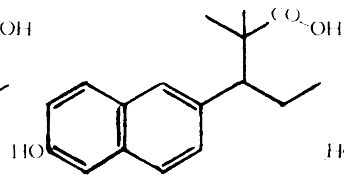
equilenin



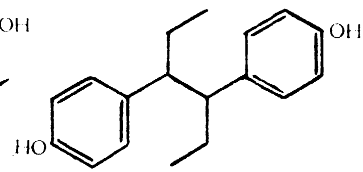
stilboestrol



doisynolic acid



allenolic acid



hexoestrol

Figure 3.

It is also noteworthy that nearly all the potent analgesics are very closely related to morphine in general molecular architecture. Morphine is not a planar molecule, but a 'three dimensional' one, and it has been found that considerable alterations to the peripheral groups may be carried out without much effect on the activity. Some changes increase the activity, others decrease it; but analgesic activity is essentially retained in all the compounds. As soon as the fundamental shape and size of the molecule is destroyed, however, as occurs when the nitrogen ring is opened (e.g., in the methylmorphimethines), the activity is destroyed (Small *et al.*, 1938). The synthetic compound N-methylmorphinan, which retains the general shape and size of the morphine molecule, but not its peripheral groups, is also active. Moreover, the various synthetic analgesics, such as pethidine, amidone, etc., also have very similar structures

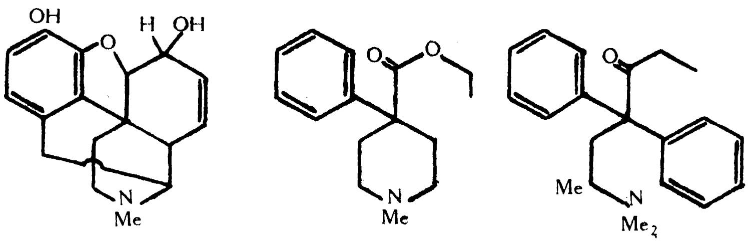


Figure 4.

which might be considered as approximating to 'open models' of morphine (Bergel and Morrison, 1948).

The Influence of Molecular Asymmetry

Observed differences in the biological activity of optical enantiomorphs are of very considerable interest as these compounds have the same chemical groups and, in general, the same physical properties. It is therefore important to determine why these compounds do exhibit differences in biological activity. The hypothesis of Easson and Stedman (1933) suggests that these differences are to be attributed mainly to the ease of attachment of the drug to the specific receptors. In a compound such as adrenaline, which has three fundamental 'active centres' (the basic group, the alcoholic hydroxyl group, and the aromatic ring with its phenolic hydroxyls), only one isomer can come into complete contact with the receptors, and it was suggested that the weaker enantiomorph behaves as if one of the active groups is not present at all. In support of the hypothesis Easson and Stedman pointed out that *d*-adrenaline has approximately the same activity as the related compound, epinine, which lacks the alcoholic hydroxyl group, and that *l*-adrenaline is very much more active. Examination of other similar compounds does not, however, show such satisfactory agreement with the hypothesis (Badger, 1947) unless it is assumed that a similarly oriented hydroxyl group sometimes assists and sometimes hinders the drug-receptor combination. This hypothesis, based as it is on the theory of receptors, implies that both enantiomorphs must form equally effective combinations, otherwise the less active isomer would partially antagonize the other when both are present together. In general this is not observed experimentally (Ing, 1943).

Cushny (1926) has suggested that each isomer combines with the same optically active tissue component to produce combinations of the same nature as diastereoisomeric salts. Such combinations would have different properties, and Cushny suggests that the intensity of the biological action is determined by the properties of the combination. It is interesting, although not necessarily significant, that the intensity of the pressor action of the *l*-mandelates of the ephedrines and ψ-ephedrines is in the reverse order of their solubilities. While data are insufficient for the full appraisal of the two theories, the suggestion of Cushny does offer a possible alternative which cannot readily be dismissed.

Other factors may also be of importance. Diastereoisomers may differ considerably in physical properties but, with certain exceptions, the physical properties of optical enantiomorphs are identical. At first sight, therefore, if such optical enantiomorphs exhibit different intensities of biological action, it would appear that the mechanism of the action cannot be attributed to a physical process. That this view may be erroneous is demonstrated by the observations (i) that optical isomers may have different partition coefficients if one of the solvents is optically active (Schröer, 1932), and (ii) that one enantiomorph may be adsorbed more strongly on an optically active surface than the other (Henderson and Rule, 1937). The differences are small, but as some lipoids are optically active it is reasonable to suppose that optical enantiomorphs may show differences in narcotic activity (which is generally accepted to be due to a physical mechanism), and this has been demonstrated experimentally (Hano, 1939).

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(*Continued on page 225*)

Discovery of Ordovician Rocks, Kimberley Division, W.A.*

D. J. GUPPY and A. A. ÖPIK

FOSSILIFEROUS ROCKS of Ordovician age were found for the first time in Western Australia in August 1949. The discovery was made by geologists D. J. Guppy and A. W. Lindner, of the Bureau of Mineral Resources, Geology and Geophysics, while engaged in detailed examination of the Devonian rocks in the Kimberley Division.

The outcrops cover approximately twelve square miles, in what is known as the Prices Creek area on Christmas Creek station, and are situated 180 miles east-south-east of Derby and 40 miles on a bearing of 145° from Fitzroy Crossing (Figure 1).

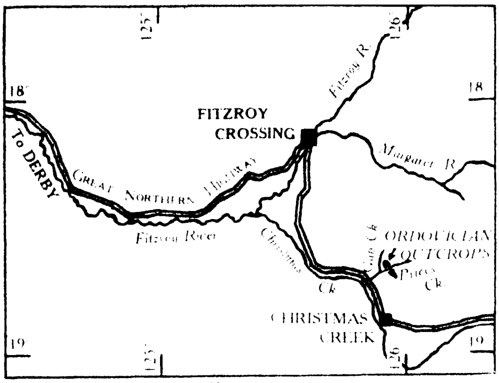

Figure 1.

The discovery of rocks of Ordovician age in the Prices Creek area is of particular interest because it was here in 1919 that mineral oil was reported in a shallow water well. As a result, in 1922 and 1923 five bores were drilled, ranging from 90 feet to 1008 feet in depth; mineral oil was reported from four of the bores. At the same time Blatchford (1927, p. 39), of the Geological Survey of Western Australia, completed a detailed survey of the Prices Creek area, and in 1924 Wade (1924, pp. 13, 20) visited the area for the Commonwealth Government. Recently the area has been mentioned in unpublished reports by Kraus (Caltex Australia Oil Development Pty. Ltd.) and Reeves (Vacuum Oil Co. Pty. Ltd.).

All previous workers have included the Ordovician rocks in the Devonian or Carboniferous Systems.

Stratigraphy

General. The Ordovician outcrops have a thickness of 2450 feet and will be referred to as the Prices Creek Group. Two formations, the Emanuel Limestone and the Gap Creek Dolomite, have been distinguished and mapped.

Emanuel Limestone. The formation name has been derived from a narrow creek (along which the type section was measured), which was named Emanuel Creek after the owner of Christmas Creek Station. Emanuel Creek and the type section are situated at 125° 55′ E. long., 18° 40′ S. lat. The formation consists of 1670 feet of light-grey limestone and calcareous shale in the type area. It is conformably overlain by the Gap Creek Dolomite and the base is obscured by faulting. A rich and well-preserved fauna is present.

Gap Creek Dolomite. This formation consists of 780 feet of light-brown dolomite with narrow sandy bands, conformably overlying the Emanuel Limestone and unconformably overlain by the Middle Devonian Pillara Limestone. The type section is adjacent to Gap Creek at 125° 55′ E. long., 18° 35′ S. lat. The formation contains an assemblage of silicified fossils.

Age of the Sediments

The lowest fossiliferous bed in the Emanuel Limestone contains the brachiopod *Obolus*, which indicates Tremadocian (Europe) or Ozarkian (U.S.A.) age (Table 1). There is no indication of any break in sedimentation at the base of the sequence; therefore lower beds of Ozarkian and possibly Cambrian can be expected. The *Obulus*-bearing limestone is overlain by limestone with asaphids of the genus *Xenostegium* Walcott, a lower Ordovician (Canadian) trilobite. The upper beds of the Emanuel Limestone contain a rich fauna of asaphids, pliomerids, gastropods and nautiloids with interbedded graptolite-bearing horizons (dichograptids). A new asaphid genus, which can be compared with *Ogygites* (*Ogygia* of older textbooks), is represented by several species. The highest beds of the formation are composed of limestone and marl containing a telephid genus which continues into the lower beds of the Gap Creek Dolomite.

The Gap Creek Dolomite contains an illaenid, perhaps *Bumastus*, together with other trilobites. A plectambonoid brachiopod, *Spanodonta hoskingiae* Prendergast is present in abundance and was originally described as an upper Palaeozoic fossil (Prendergast, 1935). The upper part of the Ordovician of Prices Creek may be correlated with the Lower Trenton of U.S.A.

A continuous sequence of Lower and Middle Ordovician is present in the Prices Creek area.

Structure

The strike of the Ordovician formations is constant at 320° and the dip ranges from 5° to 15° to the north-east. Reversals of dip and recrystallization of the limestone near the base of the section are considered to be due to an oblique fault striking at approximately 300° along the south-western boundary of the outcrops. As a result, any lower beds (Ordovician,

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TABLE I

Stratigraphic Units, Faunal Stages and Time—Correlation of the Ordovician in Price's Creek Area, W.A.

Stratigraphic Units		Faunal Stages	Faunal Sequence: Zone Fossils		Faunal Sequence: Faunal Assemblage	Tentative Time-Correlation with Ordovician of U.S.A.
UPPER MIDDLE DEVONIAN	Pillara Limestone					
Unconformity						
LOWER AND MIDDLE ORDOVICIAN Price's Creek Group	Gap Creek Dolomite	V	*Spanodonta*		*Illaenus* (*Bumastus*) Pliomerids (*Ectenonotus* ?), *Isotelus*, several genera of gastropods, ostracods, etc.	Lower Trenton
	Emanuel Limestone	IV	Telephids		Asaphidae, Asaphellinae, Pliomeridae, Agnostidae, Clitambonitidae.	Chazian
		III	Dichograptids	New genus of asaphids; Nautiloids	Ostracoda, conodonts, Bellerophontacea, several genera of gastropods including *Plethospira*.	Canadian
		II	*Xenostegium*			
		I	*Obolus*			Upper Ozarkian
Base not seen						

Cambrian or Pre-Cambrian) which may exist have been down-faulted and are now covered by Permian sandstones. Elsewhere in the area the Middle Devonian limestone, which in the Prices Creek area rests uncomformably on the Ordovician, overlies with marked unconformity the Pre-Cambrian igneous and metamorphic rocks.

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The Queensland Institute of Medical Research

THE Queensland Institute of Medical Research is a young institute. It was established in 1946 by an Act of the Queensland Parliament, and it took possession of its temporary laboratories on 2 June 1947. Basic provisions of the Act (9 Geo. VI No. 21) are:

(1) It vests control of the Institute in a Council of seven members representing medical and academic interests in Queensland.

(2) It establishes a trust fund to be maintained from consolidated revenue and administered by the Council.

(3) It requires that there shall be co-operation between the Institute, the University and the general hospitals.

(4) It provides a broad basis for the work of the Institute, namely, 'research into any branch or branches of medical science'.

The Institute is to be housed ultimately in association with the Pathology Department of the Brisbane General Hospital, but in the meantime it occupies an Army hut close to the Hospital and the Medical School. The hut has 12,000 square feet of floor space; it is divided internally into a series of useful laboratories; and an animal house has been fitted in below the main floor. Ventilation of the animal rooms is by vertical ducts opening above the roof, and the infected animal room has an inoculation cabinet provided with forced-draught ventilation and sterilization by ultra-violet light.

A considerable amount of equipment has been installed, particularly in the biochemical section, and a useful library is being accumulated. The policy here is to take those books and journals which are essential for any working laboratory to own, and then to concentrate on obtaining major periodicals which are not available in other libraries in Brisbane. To this end, and to help other workers in the State, the Librarian has issued an up-to-date

catalogue of medical and biological periodicals which are available in Brisbane libraries.

Staff

The present research staff is: I. M. Mackerras (Director), E. H. Derrick (Deputy Director—virology, pathology), M. Josephine Mackerras (parasitology, entomology), Ernest Singer (bacteriology), R. A. O'Brien (part-time—hæmatology), J. P. Callaghan (biochemistry), Dorothea Sanders (part-time—parasitology), C. G. Ludford (Research Fellow—bacteriology) and Rona Stewart (medical mycology). The broad plan is to have, ultimately, about a dozen research workers (including research fellows), with a ratio of about one to three between research and ancillary staff.

Development and education of the staff at all levels is a vital administrative function of any scientific institution. In the present instance, established workers may be sent abroad for special work (E. H. Derrick is at present in America), or may visit other scientists in Australia; senior and junior research fellowships have been established, with a maximum tenure of five years, to give promising young graduates an opportunity to make a reputation in research; a research scholarship has been established in the University to enable a pass student to take an honours B.Sc. degree or an undergraduate in Medicine to qualify for the special medical B.Sc.; and several of the junior technical appointments are to cadetships which encourage the worker in various ways to complete a pass degree in Science. In return for a substantial amount of teaching by the research staff, the University remits the fees of these students.

Thus, an unbroken series of opportunities has been provided from matriculation onwards, and it is hoped that they will bear good fruit in the future. There is no discrimination between sexes, except in the Award salaries for cadets and assistants.

The Work of the Institute

Any institution must concentrate its endeavours if its contributions are to be more than casual and superficial. The history of its foundation,* the training and experience of its staff, the environment in which they work, and the nature of the medical problems facing the State, all combine to focus the interests of the Institute on infectious disease, and particularly on those diseases which have an Arthropod vector or an animal reservoir. Within this wider field, attention is being further concentrated chiefly on problems of transmission and the conditions which influence the spread of infection. To these ends, the Institute is being organized into a series of flexible, loosely-knit sections, which may work separately or together as the trend of their work may require. Some are already functioning actively, others are still in embryo. The following notes may be taken as an indication rather than a review of the work that is being developed.

* In the Q-fever work of Derrick and his associates.

Bacteriology

This section is studying the intestinal infections of infants, and is also available to tackle bacteriological problems that may arise in the work of other sections. It was the first section to begin new work; for a severe epidemic of Salmonella infection was in progress when the Institute was opened, and it had the means to work on a field laboratory scale. The distribution and epidemiology of *Salmonella* and *Shigella* infections in Brisbane have been studied, and improvements in their control in institutions have been suggested. This work is being continued, together with an investigation of the causes of 'non-specific' enteritis.

An investigation of superficial and deep mycotic infections in Queensland will begin shortly.

Virus and Rickettsial Infections

There are still obscure fevers in Queensland, especially in the north, and they are a challenge to the curious investigator, as well as of distinct clinical and industrial significance. The attack on these problems has been crystallized into three phases:

Development of a specific laboratory test for dengue fever, in order to eliminate this diagnostic red-herring, and to provide a means for studying its epidemiology.

Application of modern methods to improve the specific diagnosis of known rickettsial, viral and some bacterial infections (it is hoped to establish a diagnostic service in association with the State Laboratory of Pathology and Microbiology).

An attack on the unidentified residue by modern methods of isolation and identification, to be followed by studies of transmission and prevention.

Equipment is nearly complete; a technician has been given special training at the Hall Institute; and E. H. Derrick is surveying recent developments abroad. The birth of this section as a working team may be said to be imminent.

Parasitology and Entomology

This section has three fields of work, general, associated, and special. In the general field it is undertaking systematic and descriptive work, building up reference collections of parasites and insects, and identifying material for other workers. In its associated work it is endeavouring to establish laboratory cultures of blood-sucking arthropods, which may be used in collaboration with the virus and rickettsial workers; and it will also collaborate

in field studies of Arthropod-transmitted infections. In its special field, there are peculiarities in the distribution and epidemiology of filariasis and malaria in Queensland which have still to be defined and explained; and there are many obscurities in the life histories and behaviour of blood parasites which can only be elucidated when suitable local strains have been established in the laboratory. This section, too, has been more heavily involved than any other in teaching work in the University.

Biochemistry

Biochemical laboratories are difficult to equip in these days of shortages and delays, so this section has had little opportunity to develop an active programme of work; but it has collaborated in a study of the fatty livers of infants who died from gastro-enteritis, and in physical studies of the sequence of events in autoclaves. Its future field lies in an investigation of the metabolism of malaria parasites, with special reference to the mechanism by which they break down hæmoglobin; studies of the possible relations of mucinases (in the broad sense) to pathogenicity of intestinal bacteria; and an endeavour to apply the radioactive tracer technique to a study of the paths of invasion of pathogenic organisms.

Pathology

Studies of morbid anatomy and histology are ancillary to other investigations. An independent investigation has, however, been made of perihepatitis following injection of mercurials in laboratory animals, and a detailed study of naturally-occurring infections and pathological processes in laboratory animals in Brisbane is being undertaken, so that the risks of error in later experimental work may be reduced.

Animal Ecology

This somewhat ambitiously named section has been conceived, but has barely reached the stage of differentiation. Its functions will be twofold: to establish laboratory colonies of native animals for experimental use; and to study the ecology of those animals which are found to be reservoirs of infection.

Publication

Work from the Institute is published in any appropriate journal. So far, about twenty papers have appeared or are in press; they are listed at the end of the *Annual Reports*.

This brief statement has naturally been more concerned with work planned than work completed. Projects will change and develop with progress, and it is one of the delights of research that the plans of five years hence may bear little resemblance to those of today.

I.M.M.

Obituary

Professor William John Dakin, D.Sc., F.Z.S.

WILLIAM JOHN DAKIN, Emeritus Professor of Zoology in the University of Sydney, Australia, died on 2 April 1950, after a painful illness extending over four years.

He was born in Liverpool, England, on 23 April 1883, and received his university training at Liverpool and Kiel. From 1908 to 1910 he was 1851 Exhibitioner in Zoology, carrying out marine research in Heligoland, Norway, and Naples. In 1911 he was appointed Lecturer in Zoology at the University of Belfast, and later filled similar positions successively in the Universities of Liverpool and London.

In 1913 Dakin came to Perth to the University of Western Australia to organize the new Department of Biology, of which he was the first Professor. In spite of heavy administrative commitments, he found time to lead a scientific expedition to the Abrolhos Islands off the Western Australian coast, and also to produce a number of important papers on the local fauna. Apart from being significant contributions to zoological knowledge, these papers are still extensively used by students in Australian universities because they were deliberately framed to have teaching value. He was President of the Royal Society of Western Australia from 1913 to 1915.

In 1920 he returned to England to take up the Chair of Zoology at Liverpool, and he remained there until 1928. During this period he was President of the Liverpool Biological Society (1922-1924) and from 1924 until 1928 he was External Examiner in Zoology to the University of London. At the end of 1928 he returned to Australia to occupy the Chair of Zoology at the University of Sydney, and held this post for the next twenty years, retiring with the title of Emeritus Professor in 1948.

Dakin came to Sydney with an impressive record as a teacher and as a scientist, and plunged into his new duties with characteristic vigour. Apart from injecting a strongly marine biological flavour into the senior Zoology courses—this was the first time that specialized training in marine biology was available to Sydney students—he quickly made his presence felt in the scientific life of the community, both inside and outside the University. In 1931 he served as President of the Royal Zoological Society of New South Wales, and he was President of the Linnean Society of New South Wales in 1934. He also became a trustee of the Australian Museum, and of the Zoological Gardens at Taronga Park, Sydney.

His really important work, however, was in the field of research. At the time of his arrival, Australian marine zoology—apart from

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

June, 1950

EDITOR: STEPHEN J. COPLAND, c.o. Linnean Society of N.S.W., Science House, Gloucester Street, Sydney.

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BIOCHEMISTRY.
(Continued.)

15199. **Lascelles, J.** Studies on Formic Hydrogenlyase in Washed Suspensions of *Escherichia coli*. *Proc. Linn. Soc. N.S.W.*, lxxiii, **1948**, **430**.—The loss of hydrogenlyase activity which occurs when washed *E. coli* suspensions are allowed to stand can be prevented by adding fermentable sugars and derivatives. Inorganic phosphate appears to be necessary for hydrogenlyase activity.

15200. **Legge, J. W.** A Note on the Disturbance of the Hæmoglobin Metabolism of the Rat by Sulphanilamide. *Biochem. J.*, xliv, **1949**, **105**.—Rats show increased urobilin output after sulphanilamide treatment; no increase in urinary coproporphyrin was observed. It was concluded that the porphyrinuria did not derive from an abnormal breakdown of hæmoglobin.

15201. **Nossal, P. M.** Decomposition of Oxalacetic Acid by Metal Compounds. *Aust. J. exp. Biol. Med. Sci.*, xxvii, **1949**, **143**.—It was shown that unneutralized solutions of oxaloacetic acid are more stable than neutral ones. The effects of temperature, buffer type, pH and metals on the decomposition process were studied.

15202. **Nossal, P. M.** The Metabolism of Erythrocytes. ii. The Decarboxylation of Oxalacetate by Blood. *Aurt. J. exp. Biol. Med. Sci.*, xxvi, **1948**, **531**.—The spontaneous decarboxylation of oxalacetate was studied with regard to pH and metallic ions. There is also an enzymic decomposition brought about by rabbit blood and this process does not involve thiamine nor (to a very marked degree) Mg and Mn.

15203. **Nossal, P. M., and Kerr, D. I. B.** The Metabolism of Erythrocytes. iii. Identification of One Blood Decarboxylation System. *Aust. J. exp. Biol. Med. Sci.*, xxvi, **1948**, **553**.—Oxalacetate decarboxylation by blood systems was reinvestigated and in addition to confirming previous findings it was shown that simultaneously oxyhæmoglobin is converted to methæmoglobin and finally to acid hæmatin. The whole question of the decarboxylation systems in blood is discussed.

15204. **Slater, E. C.** The Measurement of the Cytochrome Oxidase Activity of Enzyme Preparations. *Biochem. J.*, xliv, **1949**, **305**.—A procedure for studying the true activity of cytochrome oxidase is described. This involves measuring the rate of oxidation at different cytochrome C concentrations and extrapolation to infinite concentration.

15205. **Steinbeck, A. W.** The Sodium Sulphite "Albumin" Fraction of Human Plasma, and Notes on its Estimation. *Aust. J. exp. Biol. Med. Sci.*, xxvii, **1949**, **55**.—It is recommended that filtrates for albumin estimation should be prepared with 26·5 and 27·5% sulphite and the results averaged, to allow for possible solubility curve displacements.

15206. **Still, J. L., Buell, M. V., Knox, W. E., and Green, D. E.** Studies on the Cyclophorase System. vii. D-aspartic Oxidase. *J. biol. Chem.*, clxxix, **1949**, **179**.—A new enzyme (soluble D-aspartic oxidase) has been found in rabbit kidney and liver. Aspartic acid is converted aerobically into ammonia and oxalacetic acid. In cyclophorase preparations, D-aspartic acid undergoes complete oxidation to carbon dioxide and ammonia.

ENTOMOLOGY.
Hon. Abstractor: A. Musgrave.

15207. **Allman, S. L., and Friend, A. H.** New Insecticides and Fruit Fly Control. *Agric. Gaz. N.S.W.*, lix (10), Oct. **1948**, **531–533**, illustr.

15208. **Andre, M.** Description d'*Agauopsis brevipalpus* Trouessart (Halacarien). *Bull. Mus. nat. d'Hist. nat.*, Paris, (2) xiv (6), Oct.-Dec. **1942**, **411–413**, figs.—Types in Paris Museum are here redescribed. Stated to be from the Azores, Canaries, Bermuda, Brazil and Sydney, Pacific Ocean.

15209. **Armstrong, J. W. T.** On Australian Dermestidæ. Part v. Notes and the Description of Four New Species. *Proc. Linn. Soc. N.S.W.*, lxxiv (1–2), June **1949**, **107–111**, 1 tf.—*Trogoderma silvicolum* n.sp., Acacia Plateau and Acacia Creek, N.S.W.; *T. inconspicuum* Armst., note, Swan R., Wurarga, W.A.; *T. longius* Blackb., 1903, note, Glenelg R., V. (type loc.), Tas., Acacia Plateau, N.S.W.; *T. carteri* Armst., Bogan R., N.S.W. (type loc.), descr. ♂; *T. callubriense* (Armst.), Bogan R., N.S.W. = *Psacus callubriensis* Armst.,

1945. *Megatoma foveolatus* Lepesme, Australia *Adelaidia rigus* Blackb., S. Australia (type loc.), Bogan R., N.S.W., descr. ♂. *Anthrenocerus arrowi* n.sp. Syn. *A. bicolor* Armst. nec. Arrow, Bogan R., N.S.W., Townsville, Q., Yallingup, southern W.A., widespread in southern and eastern Australia; *A. blackburni* Armst., note, Victoria; Bombala, Illawarra, Acacia Plateau, N.S.W.; *A. stigmacrophilus* n.sp., Bogan R., N.S.W., in nests of a small ant, *Stigmacros foreli* Viehm. during November. *Anthrenus vorax* Waterh., N.S.W.: Trangie, note. *Orphinum nealensis* (Blackb.), syn. *Crypterhopalum nealense* Blackb., Oodnadatta, S.A., Bogan R., N.S.W., on myall, *Acacia pendula*. *Neoanthrenus macqueeni* sp.n., Milmerran, S. Q'ld.; *N. parallelus* Armst., Lane Cove, N.S.W. (type loc.), National Park, Q.

15210. **Attems, C. G.** Neue Polydesmoidea. *Zool. Anz.*, Leipzig, cxliv (11–12), 1944, 223–251, tfs. 1–42.—*Australiosoma castaneum* sp.n., S. Australia.

15211. **Baker, E. W.** A Review of the Mites of the Family Chelytidæ in the United States National Museum. *Proc. U.S. Nat. Mus.*, xcix (3238), 1949, 267–320, pls. 6–17.

15212. **Belschner, H. G.** Sheep Ked (" Tick ") Causes Unthriftiness and Wool Damage. *Agric. Gaz. N.S.W.*, lx (3), March, 1949, 159–162, illustr.—*Melophaginus ovinus.*

15213. **Brimblecombe, A. R.** Fruit-spotting Bug as a Pest of the Macadamia or Queensland Nut. *Q'land Agric. J.*, lxvii (4), Oct. 1948, 206–211, pls. 62–66.—Macadamia flower caterpillar, *Homoeosoma vagella* Zell. Macadamia nut grub, *Arotrophora ombrodelta* Lower. Fruit-spotting bug, *Amblypelta lutescens* Dist. and on many introduced and native plants.

15214. **Brooks, J. G.** North Queensland Coleoptera and their Food Plants. Part ii. *Nth. Q'land Nat.*, Cairns, xvi (89), Dec. 1948, 6–7.

15215. **Brown, W. L. (Jr.).** A Preliminary Generic Revision of the Higher Dacetini (Hymenoptera: Formicidæ). *Trans. Amer. Ent. Soc.*, lxxiv, July 1948, 101–129, tfs. 1–2.—*Labidogenys* Roger, genotype *L. lyroessa* Roger, 1862, includes *L. emdeni* Forel, from Australia, and ? *L. biroi* Emery, from N. Guinea. *Smithistruma* n.g. Orthotype, *Strumigenys pulchella* Emery, 1895, also subg. descr. nearly world-wide. *Colobostruma* Wheeler, genotype *Epopostruma* (*Colobostruma*) *leae* Wheeler, 1927, Cairns dist., Q. *Mesostruma* n.g. Orthotype, *Strumigenys* (*Epopostruma*) *turneri* Forel, 1895. *Epopostruma* Forel, 1895. Genotype, *S.* (*E.*) *quadrispinosa* Forel, 1895. *Hexadaceton* n.g. Genotype, *H. frosti* n.sp. " N. Mecklenburg ", S. Australia. *Clarkistruma* n.g. Orthotype, *Epopostruma alinodis* Forel, 1913; *alinodis* and *elliotti*, both Australian-Tasmanian.

15216. **Brug, S. L., and Bonne-Wepster, J.** The Geographical Distribution of the Mosquitoes of the Malay Archipelago. *Chronica Naturæ*, Batavia, ciii (10–11), Oct.-Nov. 1947, 179–197.—A catalogue of the mosquito species and varieties found in the Oriental and Australian regions and showing their distribution over the various islands. It is shown that there is no distinct boundary between the Oriental and Australian zoo-geographical regions. A line dividing the archipelago in regions with mainly Oriental and with mainly Australian mosquitoes would run between Ceram and New Guinea and somewhere between Timor and New Guinea, further east than Wallace's Line.

15217. **Burns, A. N.** Insects Collected at Mud Islands, Port Phillip Bay, November 30, 1945. *Mem. Nat. Mus. Vict.*, No. 15, Oct. 1947 (Aug. 1948), 143–145.

15218. **Burns, A. N.** The Classification and Distribution of Butterflies. *Vict. Nat.*, lxv (5), Dec. 1948, 125–126.

15219. **Burns, A. N., and Oke, C.** A Preliminary Report on the Biology and Ecology of the Snowy River Area in North-Eastern Victoria. Insects and Arachnids. *Mem. Nat. Mus. Vict.*, No. 15, Oct. 1947 (Aug. 1948), 168–171.

15220. **Caldwell, N. E. H.** Codling Moth Control Experiments, 1945–47. *Q'land J. Agric. Sci.*, Brisbane, v (2), June 1948, 61–76.—In these experiments DDT, benzene hexachloride and zinc fluoarsenate were tested officially for the first time in Queensland. It is concluded that, under Queensland conditions, DDT at a concentration of 0·1 per cent. is an efficient cover spray in the codling moth control programme. Its superiority over materials is likely to be most marked in seasons of severe moth incidence.

15221. **Cannon, R. C.** Investigation in the Control of the Potato Tuber Moth, *Gnorimoschema operculella* Zell. (Lepidoptera: Gelechiidæ), in North Queensland. *Q'land J. Agric. Sci.*, Brisbane v (3), Sept. 1948, 107–124.

15222. **Chadwick, C. E.** Notes and Exhibits. *Amblypelta nitida* Stal (Coreidæ) and *Lampromicra aerea* Dist. (Pentatomidæ). *Abstr. Proc. Linn. Soc. N.S.W.*, No. 598, 26 Nov. 1948, p. 2.—Records these plant bugs as harmful by causing pitting in peaches and other fruits.

15223. **Chopard, L.** Description de deux Sténopelmatides cavernicoles d'Australie (Orth. Gryllacridæ). *Bull. Soc. ent. France*, 1944, xlix (4–5), 1945, 52–55, 2 figs.

15224. **Compere, H.** A New Genus and Species, *Eurymyiocnema aphelinoides* (Hymenoptera, Aphelinidæ), and a History of the Genera *Euryischia* Riley and *Myiocnema* Ashmead. *Bull. Ent. Res.*, xxxviii (3), Dec. 1947, 381–388, tfs. 1–4.—The two last-named genera contain Australian spp. of economic importance.

15225. **Compere, H.** A Report on a Collection of Encyrtidæ with Descriptions of New Genera and Species. *Univ. Calif. Publ. Ent.*, viii (1), Sept. 1947, 1–24, tfs. 1–7.—Contains references to Australian species.

15226. **Condon, R. W.** Mulga Death in the West Darling Country. *J. Soil Conserv. Serv. N.S.W.*, v (1), Jan. 1949, 7–14, illustr.—*Heteronyx* sp. attacking roots of *Acacia aneura.* Termites attack roots (sapwood). Borers attack roots, tunnelling through heartwood and chewing away sapwood. *Heteronyx* sp. also attacks roots of Leopard-wood trees, *Flindersia maculosa.*

15227. **Corbet, A. S.** Papers on Malaysian Rhopalocera. ii. The Type of *Papilio leucostictos* Gmelin, 1790. *Entom.*, lxxx (1013), Oct. 1947,

228–229, pl. iv, f. 1.—*Papilio Danaus leucostictos* Gmelin, 1790, in *Linn. Syst. Nat.*, ed. 13, i, pt. 5, 2289, " Habitat extra Europam ". Labelled also *Leucostictos*, Gmel. 48. Type from Mus. Lesk. = Amboina not Java.

15228. **Corbet, A. S.** Papers on Malaysian Rhopalocera. v. The Conspecificity of the American *Precis lavinia* (Cramer) with the Oriental *Precis orithya* (Linnæus). *Entom.*, lxxxi (1018), March 1948, 54–56, tfs. 1–8.—*Precis vellida* from Australia.

15229. **Corporaal, J. B.** Third Series of Notes on Systematics and Synonymy. *Ent. Ber.*, xii (286), Jan. 1949, 326–328.—Transfers *Natalis leai* Blackb. 1899 to *Metademius*, following Schenkling in transferring *Opilo floccosus* Schklg, 1898, to this genus—Australian species.

15230. **Corporaal, J. B.** Fifth Series of Notes on Systematics and Synonymy. *Ent. Ber.*, xii (288), April 1949, 355–357.—Cleridæ: *Phlogistus episcopalis* Spinola, 1844, a syn. of *Phl.* (*Clerus*) *instabilis* Newm. 1840. *Phl.* (*Aulicus*) *episcopalis* Blackb., 1900. *Phl. episcopalis* Hintz, 1908, *Phl. Hintzi* nov. nom. *Elasmocerus picticollis* Blkb., 1901 (Victoria) = *Monophylla terminata* Say (North America), introduced on grape vines ?. *Trogodendron* Spinola 1841, ex Guerin-M., MSS.

15231. **Couchman, L. E.** Notes on the Lepidoptera Rhopalocera of Tasmania. *Rec. Queen Vic. Mus. Launceston*, ii (2), Dec. 1948, 93–96.

15232. **Cresson, E. T. (Jr.).** A Systematic Annotated Arrangement of the Genera and Species of the Indo-Australian Ephydridæ (Diptera). ii. The Subfamily Notiphilinæ and Supplement to Part I on the Subfamily Psilopinæ. *Trans. Amer. Ent. Soc.*, lxxiv, March 1948, 1–28.—Among the Australian species listed the following are described as new: *Hydrellia huttoni* n.sp. for *Hydrellia enderbyi* Cresson, 1932, not *Drosophila enderbyi* Hutton, redescribed as *Hydrellia enderbyi* by Tonnoir and Malloch, 1926, type ♂, Victoria, 1888 (Acad. Nat. Sci. Philad.) ; paratype ♂, same data. *Eleleides chloris* n.g. et sp., type ♂, Victoria, 1888 (Acad. Nat. Sci. Philad.), paratypes 3 ♂, 2 ♀, same data.

15233. **Davey, H. W.** Guests of Ants, Welcome and Otherwise. *Vict. Nat.*, lxiv (9), Jan. 1948, 180–182.

15234. **Day, M. F.** The Distribution of Ascorbic Acid in the Tissues of Insects. *Aust. J. Sci. Res.*, (B) ii (1), Feb. 1949, 19–30, pls. 1–3.

15235. **Day, M. F.** The Distribution of Alkaline Phosphatase in Insects. *Aust. J. Sci. Res.*, (B) ii (1), Feb. 1949, 31–41, pls. 1–3.

15236. **Diakonoff, A.** In memoriam Alfred Jefferis Turner de nestor van de Australische Lepidopterologie. *Ent. Ber.*, xii (287), March 1949, 329–330.

15237. **Dillon, L. S., and Dillon. Elizabeth S.** The Tribe Dorcaschematini (Coleoptera : Cerambycidæ). *Trans. Amer. Ent. Soc.*, lxxiii, Jan. 1948, 173–298.—*Olenecamptus* Chev., 1835. Genotype, *O. serratus* Chev. *O. bilobus bilobus* Fabr., 1801, descr. 0, N. Australia. Specimens from Queensland. *Cylindrepomus grammicus hecate* subsp.n. Types from Solomon Is., Australia, Fiji.

15238. **Dixey, F. A.** The Pierinæ of the Collection of the late Admiral Edmund G. Bourke now in the Hope Department of the University Museum, Oxford. *Ent. Mo. Mag.*, lxix (827), April, 92–96 ; (828), May, 97–102.—Includes specimens from Queensland, S. Australia and New South Wales.

15239. **Drake, C. J.** New Genera and Species of Tingidæ (Hemiptera). *Proc. Biol. Soc. Wash.*, lxi, Sept. 1948, 149–156.—*Perissonemia sodalis* sp.n., Redlynch, N.Q. ; type, ♂, allotype ♀. *Bunotingis* n.g. Genotype, *Cysteochila camelina* Hacker. *Oncophysa leai* sp.n. Geraldton and Mullewa, Australia.

15240. **Dunn, R. A.** A New Salticid Spider from Victoria. *Mem. Nat. Mus. Vict.*, No. 15 Oct. 1947 (Aug. 1948), 82–85, tf. 1.—*Saitis p onis* sp.n. Carnegia and Altona, V.

15241. **Edwards, E. O.** Notes on Butterflies of Western Queensland. *Aust. Zool.*, xi (3), Feb. 1948, 225–232.

15242. **Eliot, N.** More on Continental Drift, *Precis lavinia* Hb. and *P. villida* F. *Entom.*, lxxx (1013), Oct. 1947, 230–234.

15243. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lix (9), Sept. 1948, 475–477, illustr.—Citrus aphids, *Toxoptera aurantii* and *Aphis* sp. Cutworms (Noctuidæ), control measures.

15244. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lix (10), Oct. 1948, 537–538. E. 605, an interesting new insecticide, tests upon Olive Lace Bug, *Froggattia olivina* ; Green Peach Aphid, *Myzus persicæ* ; House Fly, *Musca domestica* ; Fowl Lice and the Fowl Mite, are discussed by P. C. Hely and A. H. Friend.

15245. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lix (11), Nov. 1948, 601–603, illustr.—Green Peach Aphid, *Myzus persicæ*.

15246. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lix (12), Dec. 1948, 649–652, illustr.—Red Mite, *Bryobia prætiosa*, pest to orchardists attacking pome and stone fruit, and clovers, grasses, etc., control. Hover flies, *Xanthogramma grandicornis*, and Ladybird beetles, *Coccinella repanda*, played an important part in the destruction of aphids during October and November, 1948.

15247. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lx (1), Jan. 1949, 41–44, illustr.—White Wax Scale, *Ceroplastes destructor*, control by soda sprays. Red Scale, *Aonidiella aurantii*, control by hydrocyanic acid gas, and emulsified petroleum oil. Tomato Mite, *Vasates destructor*, control by sulphur dusts or sprays or DDT emulsion spray.

15248. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lx (2), Feb. 1949, 96–98, 100, illustr.—The Green Vegetable Bug, *Nezara viridula*, control. Red-legged Earth Mites, *Penthaleus major* and *Halotydeus destructor*, control.

15249. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lx (3), March 1949, 147–151, 168, illustr.—Mushroom flies, *Sciara* sp., *Hypogastrura armata*. *Onychiurus ambulans*. Mushroom mites. Minor pests.

15250. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lx (4), April 1949, 199–202, illustr.—Forecasting insect plagues. The European Earwig, *Forficula auricularia*.

15251. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lx (5), May **1949**, **258–262**, illustr.—Insect pests of maize: Cutworms (Noctuidæ). The Army Worm, *Cirphis unipuncta*. The Corn Ear Worm, *Heliothis armigera*. The Black Beetle, *Heteronychus sanctæ-helenæ*. The Yellow Maize Moth, *Dichocrocis punctiferalis*. The Yellow Monolepta Beetle, *Monolepta rosea*. The Pink Corn-Worm, *Batrachedra rileyi*. Pests of stored maize: The Common Grain Weevil, *Calandra oryzæ*. The Common Grain Moth, *Sitotroga cerealella*. Control measures.

15252. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lx (6), June 1949, 297–301, illustr.—The Gladiolus Thrips, *Tæniothrips simplex*. Fuller's Rose Weevil, *Pantomorus godmani*, discussed by P. C. Hely. Methods of control.

15253. **Entom. Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lx (7), July **1949**, **373–378**, illustr.—Aphids or Plant Lice (Aphididæ).

15254. **Evans, J. W.** A New Leaf-hopper from Victoria (Homoptera, Jassidæ). *Mem. Nat. Mus. Vict.*, No. 15, Oct. 1947 (Aug. **1948**), 126–127, tf. 1.—*Nesoclutha* n.g. Haplotype, *N. obscura* sp.n. Melbourne, V.

15255. **Evans, J. W.** Some Observations on the Classification of the Membracidæ and on the Ancestry, Phylogeny and Distribution of the Jassoidea. *Trans. R. Ent. Soc. Lond.*, xcix (15), Dec. **1948**, **497–515**, 10 figs.

15256. **Fonseca, F. D.** A Monograph of the Genera and Species of Macronyssidæ Oudemans, 1936 (Synom.: Liponissidæ Vitzthum, 1931) (Acari). *Proc. Zool. Soc. Lond.*, cxviii (2), Aug. **1948**, **249–334**, tfs. 1–54.—*Bdellonyssus* Fonseca; *B. bacoti* (Hirst, 1913); *B. bursa* (Berlese, 1888).

15257. **Forster, R. R.** A New Harvestman of the Subfamily Liobuninæ from Australia. *Mem. Nat. Mus. Vict.*, No. 15, Oct. **1947** (Aug. **1948**), 174–177, tfs. 1–9.—*Nelima dunni* sp.n. Melbourne, V.

15258. **Forte, P. N.** An Experience in Argentine Ant Control. *J. Dept. Agric. W.A.*, (2) xxvi (1), March **1949**, **29–32**, illustr.

15259. **Freeman, P.** A Revision of the Genus *Dysdercus* Boisduval (Hemiptera, Pyrrhocoridæ) Excluding the American Species. *Trans. R. Ent. Soc. Lond.*, xcviii (8), Nov. 1947, **373–424**, 59 figs.—*Dysdercus* Bsd., def. Type by subsequent designation, *D. decussatus* Bsd., 1835, key to spp. *D. cingulatus* (Fab., 1775), Australian locs.; extra-limital. *D. sidæ* Montr., 1861, Australian locs.; New Guinea and Pacific Is. *D. longiceps* Breddin, 1901, Torres St.; Cornwallis I.; Port Darwin. *D. argillaceus* Bergr., 1895, Q'land; New Guinea: Kokoda; Torres St.: Cornwallis I. *D. decussatus* Bsd., 1835, Australian locs.; extra-limital.

15260. **Friend, A. H.** The Fruit Fly Problem and Some Details of Recent Control Tests. *Agric. Gaz. N.S.W.*, lx (1), Jan. **1949**, **35–39**.

15261. **Friend, A. H.** Further Experiments on the Control of the Queensland Fruit Fly (*Strumeta tryoni*). *Agric. Gaz. N.S.W.*, lx (6), June **1949**, **307–308**, **334**.

15262. **Gellatley, J. G. G.** Insect Pests. New Insecticides on Aphids. Some Preliminary Tests. *Agric. Gaz. N.S.W.*, lix (10), Oct. **1948**, **540–541**.

15263. **Gilmour, E. F., and Dibb, J. R.** Revision of the Batocerini. (Col., Cerambycidæ, Lamiinæ.) *Spolia Zeylanica*, Colombo, xxv (1), Dec. **1948**, 1–121, pls. 1–10.—Key to the Batocerini. *Batocera* Cast., 1840; *B. wallacei* Thomson, 1858, Cape York; Aru I.; N. Guinea. *B. boisduvali* Hope, 1839, Swan R.; Q'land: Moreton; N.S.W.: Richmond R.; S.A.: Adelaide. *B. læna* Thoms. var. *sappho* Thoms., 1878. N. Q'land; Key I. *B. læna* var. *frenchi* v. d. Poll, 1887, Q'land; N.S.W.

15264. **Golding, N. K.** Lice Infestation in Sheep. A Notifiable Disease that Causes Considerable Losses. *Agric. Gaz. N.S.W.*, lx (6), June **1949**, **315–320**, **334**, illustr.—Two species commonly affect sheep in New South Wales, the Body Louse, *Damalinia ovis* (= *Trichodectes sphærocephalus* or *Bovicola ovis*); the Foot Louse, *Linognathus pedalis*. Control measures.

15265. **Goodnight, C. J., and Marie L.** New Phalangids from the South-west Pacific. *Amer. Mus. Nov.*, New York, No. 1371, May 1948, 1–14, 11 tfs.—*Zalmoxis darwinensis* n.sp. Darwin, Australia. *Anjolus* n.g. Orthotype, *A. malkini* n.sp. Anjo Penin., coast of W. Aust.

15266. **Graham, N. P. H., and Scott, Marion T.** Observations on the Control of Some Ectoparasites of Sheep. i. The Use of Arsenic, Rotenone, Sulphur, and Phenol Compounds for the Control of the Sheep Ked (*Melophagus ovinus*) and the Sheep Body Louse (*Damalinia ovis*). *J. C.S.I.R.*, Melbourne, xxi (4), Nov., 252–265.

15267. **Graham, N. P. H., and Scott, Marion T.** Observations on the Control of Some Ectoparasites of Sheep. ii. Progress Report on the Use of DDT and Benzene Hexachloride for the Control of the Sheep Ked (*Melophagus ovinus*) and the Sheep Body Louse (*Damalinia ovis*). *J. C.S.I.R.*, Melbourne, xxi (4), Nov., **1948**, 266–274.

15268. **Grandi, Guido.** Catalogo Ragionato degli Agaonidi di tutto il mondo descritti fino ad oggi. (3a ed.) *Boll. Ist. Ent. Bologna*, xiii (1), Nov. 1941, 1–28.

15269. **Grandjewn, F.** Au sujet des Erythroides. *Bull. Mus. Nat. d'Hist. Nat.*, Paris, (2) xix (4), Sept. 1947, 327–334, tfs. 1–2.

15270. **Griswold, Grace H.** Studies on the Biology of the Webbing Clothes Moth (*Tineola bisselliella* Hum.). *Cornell Univ. Exper. Stat. Mem.* 262, June 1944, 1–59, tfs. 1–24.—This insect is the common clothes moth of Australia and is everywhere abundant and destructive to woollens, furs and household furnishings.

15271. **Gurney, A. B.** Notes on Some Remarkable Australasian Walkingsticks, including a Synopsus of the Genus Extatosoma (Orthoptera: Phasmatidæ). *Ann. Ent. Soc. Amer.*, xl (3), Sept. 1947, 373–396, pls. i–vii.—*Extatosoma* Gray, 1833, key to spp.; *E. tiaratum* (W. S. Macleay, 1826), cites Q'land and N.S.Wales locs. of specimens in American museums. *E. elongatum* Froggatt, from N.S.Wales, refers to Froggatt's locs. *Dryococelus* n.g. Orthotype, *Karabidion australe* Montrouzier, 1855, from Lord Howe Is.

taxonomic work—was in a very backward state, both in the field of pure science and in its applied aspects. He instituted a series of pioneering researches into the plankton of the New South Wales coast, even though he was forced in the beginning to use a ten-foot dinghy as a research vessel. Later on, a 35-foot yacht, the *Thistle*, was acquired as the property of the Department, and also a marine biological station on the military reserve at South Head, Sydney Harbour. This speeded things up considerably, and for the first time it was possible to publish information on the general hydrology and the biology of the plankton of Australian seas. At that time fisheries research in New South Wales was practically at a standstill, this in spite of the fact that the important trawling industry was having a bad time through a serious falling-off in fish stocks. Within a very short time Dakin had made arrangements for numbers of his trained students to go out on commercial trawlers to study fisheries problems at first hand; and perhaps his culminating effort in this field was the part he played in the founding of the C.S.I.R.O. Fisheries Laboratory at Cronulla, near Sydney. This institution has, over the years, produced an impressive volume of fisheries research.

Dakin's love was first and foremost the sea, but his interests in marine biology ranged over a wide field. He published something like 60 papers on a diversity of topics, and while a few of these were necessarily of a taxonomic nature, experimental physiological research appealed to him most. His chief experimental work was concerned with the osmotic relations of the body fluids of aquatic animals, a subject in which he had been interested from the earliest stages of his career, and one which he and his fellow workers pursued for many years after his arrival in Sydney.

With the entry of Japan into the second world war, he convened a committee consisting of engineers, architects, artists and others to study problems of camouflage as applied particularly to Australian defence, but for a long time the ruling government refused to give the committee official recognition. Eventually the importance of its work was recognized and Dakin was appointed Technical Director of Camouflage for the Commonwealth of Australia, a post which he held until the close of the war. By this time he had built up a large organization which not only attended to such minor matters as the instruction of voluntary workers in the making of camouflage nets, but also trained camoufleurs for the various battle zones, carried out original research in the principles of camouflage, and acted as a centre to which service chiefs could come for advice on their particular problems of concealment of military objectives.

In 1949, at the Hobart Conference of the Australasian Association for the Advancement of Science, Dakin was awarded the Mueller Medal for distinguished services to Australian science, this being a fitting recognition of his outstanding work.

One of his notable features was his great versatility and the width of his interests. He was a brilliant lecturer, and an expert on yachting, photography and radio design. He was also an acknowledged authority on whaling, a tireless campaigner for the wider teaching of Biology in schools, a fine pianist, and a landscape artist of considerable merit.

Dakin achieved tremendous popularity as a radio broadcaster, his aim being to bring science to the people in a readily understandable form. It is doubtful whether any other local broadcaster in this field has enjoyed such a large listening audience. Curiously enough, this activity incurred a certain amount of criticism from some of his colleagues; but in the writer's opinion, these talks must have increased the prestige of the University in the eyes of the man in the street, who ordinarily is singularly unaware of the existence of such an institution.

Apart from the 60 published research papers, Dakin also wrote two textbooks, a history of Australian whaling, a small work on the principles of camouflage, and numerous magazine and newspaper articles on biological subjects.

In the past four years, during which his life was despaired of on several occasions but which did yield intervals of comparative freedom from pain, he worked with his usual tireless energy on a major work concerned with the ecology of the Australian sea shores. The field work, the writing of the manuscript, and the preparation of the photographic plates were completed by the end of 1949 and handed over to the publishers. Unfortunately, he died before the book had time to appear, even in proof form.

He is survived by his widow, Catherine Mary Dakin, and one son, Dr. W. P. H. Dakin.

A. N. COLEFAX.

Frederick Thomas Peirce

FREDERICK THOMAS PEIRCE died at Dee Why, near Sydney, on 11 April 1950, after a long illness. By his death the textile world has lost an outstanding pioneer in the application of physics and mathematics to the study of textiles.

Peirce was born in Brisbane and spent his youth in Maitland, New South Wales, where his father was editor of a local paper. He graduated in Physics and Mathematics at the University of Sydney in 1915 and was awarded the Barker Travelling Scholarship. Later, the University awarded him the D.Sc.

In World War I he served in the Signal Corps of the Australian infantry forces and in the Australian Light Horse in the Near East, where he was wounded just as he was

about to transfer to the Flying Corps. That war claimed his elder brother, S. E. Peirce, whose name is known to physicists from the Bragg-Peirce law of absorption of X-rays. At the end of the war he took up his travelling scholarship and worked under W. H. Bragg at University College, London.

The Shirley Institute, Manchester, the headquarters of the British Cotton Industries Research Association, had just been established when Peirce joined it in 1921 as a senior assistant. In 1924 he was appointed head of the Testing Department. This department became responsible under Peirce for most of the physical work of the Institute. Its function was to study the raw materials and develop physical methods of assessing and measuring the properties of textiles, rather than to undertake routine testing. At the outbreak of the last war his department had a staff of over 60 people.

Among the large number of papers which Peirce published was one in 1937 on the *Geometry of Cloth Structure*, in which he showed how many of the important properties of cloths may be analysed mathematically on the basis of the geometry of the structure and may be expressed in terms independent of the scale of the weave. This work has had far-reaching effects in the cotton industry and had important applications during the war. Thus, for example, as a result of the blitz, there was a great demand for watertight canvas for fire hoses and for temporary water tanks. Such canvas had generally been made of flax, which was in short supply. Peirce's knowledge of the relation between water permeability and the geometry of cloth structure enabled him to provide a formula for the manufacture of watertight canvas using cotton. The same ideas were applicable to the problem of clothing needed for the fighting forces in the tropics which would be cool, waterproof and at the same time permit passage of water vapour for ventilation. The result was the production of much better materials for the allied forces in tropical theatres.

Peirce showed that his ideas on cloth engineering provided general formulae applicable to the construction of fabrics ranging from the coarsest canvases to materials of very light weight, all with excellent waterproof properties. The manufacture of these so-called Shirley cloths involves somewhat greater uniformity of yarn and more care than in normal manufacturing procedures. In Great Britain an effective liaison between manufacturer and scientist has been set up to maintain the required standard of production.

Peirce's work came to the notice of the United States Quartermaster-General's Department and arrangements were made by the British Government for him to be sent to the United States and Canada in 1944 to advise on the design of fabrics for the U.S. army in the tropics; also for the Canadian forces. In the United States he was impressed with the facilities for research and technological development in textiles, and in 1945 accepted an invitation to become Director of Textile Research in the University of North Carolina; for he believed that nowhere was there a better opportunity for creating a school of modern scientific technology in the field of textiles than at this institution.

Peirce retained a great affection for his native country and willingly accepted an invitation by the Commonwealth Government to visit Australia late in 1945 with other experts to advise C.S.I.R. on wool research. Unfortunately, shortly after his return to U.S.A. he suffered a stroke which seriously incapacitated him. His family brought him to Sydney, where he died aged fifty-three. He is survived by a widow and three daughters.

G. H. BRIGGS.

Dansie Thomas Sawkins*

DANSIE THOMAS SAWKINS, whose death occurred on 22 March 1950, was born on 1 August 1880 at Muswellbrook, N.S.W. From Maitland High School he went on to the University of Sydney, where he took the Medal for Mathematics on graduating as B.A. in 1899. He graduated M.A. in 1902 and went overseas to Queen's College, Cambridge, holding the James King of Irrawang Travelling Scholarship. At Queen's he became a Foundation Scholar in 1903, and at graduation was a Wrangler in 1904.

For a few years (1904-1907) he was a master at Rossall School in England, but Sawkins had no love of school teaching, to which he always referred in slightly bitter tone. He found his escape in going as a surveyor to Siam and the Federated Malay States for five years, until health dictated his leaving the tropics. This brought him back to his native State of New South Wales, initially as a surveyor in the State service. In 1917 he finally 'found his line', to use his own favourite term, when he became Statist to the Board of Trade, the organization which preceded the Industrial Commission. He held the post of statist continuously with these two authorities until he joined the full-time staff of the University in 1938.

His university career, however, had begun much earlier, when he became part-time lecturer in Statistics in 1922, and P. N. Russell Lecturer in Geodesy in 1924. The work in Economics developed considerably, while other faculties, especially Science, increasingly felt the need for training in Statistics. Accordingly Sawkins, in 1938, accepted a full-time post of Reader in Statistics in addition to his continued tenure of the P. N. Russell lectureship in the Department of Civil Engineering.

* From *The Union Recorder*, University of Sydney, *30*, 131, 1950.

Characteristically his entry in *Who's Who* records only two publications by name, *The National Diet*, 1922, and *The Living Wage in Australia*, 1933; and adds 'articles and papers for periodicals and scientific journals'. Few would deduce from this the long list of papers published both in Australia and abroad, mainly on statistical technique and on the subject which specially interested him, the logical nature of statistical concepts. He was a regular contributor to *Metron*, but his work turns up in all sorts of places. Not many, for example, of those whose business it is to know such things are aware that the only serious data on wages in the later part of the nineteenth century in Australia are to be found in an appendix by Sawkins to a *Report on Apprenticeship* of the Board of Trade.

His clear appreciation of the difficulties that lie at the bases of the theory of Mathematical Statistics enabled him to clarify and correct the accounts of it in current textbooks—to the great advantage of the better students. A recent and widely used textbook by C. E. Weatherburn, of Western Australia, owes much to suggestions and criticisms made by Sawkins in correspondence while the book was being written. Sawkins's lectures on Geodesy were all the more stimulating to senior engineering students because they contained so little Geodesy. That could be read from the textbook; appreciation of general principles of measurement and assessment of data came from Sawkins. Examination papers in Geodesy would inquire of the surveying student whether a shopkeeper would become bankrupt if he gave a certain guarantee in selling electric lamps.

Sawkins's lecturing manner was disturbing to the commonplace student but a delight to the connoisseur. Generations of students will recall the carefully-timed slightly late arrival, the placing on the lectern of a small suitcase, lid opened to conceal contents from the class, the unpacking of masses of papers which were carefully arranged on the desk and then ignored, the cheerful grin which signalled the digression with which every lecture began. There were the pretences of calculating tricks, in which the joke was meant to be shared with those who were alert enough to know it couldn't be done, at the expense of the naïve who did not realize that Sawkins had the answer ready on a slip of paper; there was the sudden dive behind the lid of the suitcase, which students swore was Sawkins having a sandwich in place of the meal for which there had not been time after he left his office downtown; then the unnerving and unpredictable plunge down into the class to discover what some puzzled student was writing in his notes.

Few of the students who passed through these lectures knew, as his colleagues did, how tolerant he was of the serious student who found the subject difficult; but many owe their degrees to the principle which Sawkins would owlishly announce when asked to explain a pass granted to one student on a lower mark than had earned another a failure: 'He got it all wrong, but he seemed to know what he ought to be doing'.

Outside, he had a varied range of interests. He liked using his hands, and showed that he could use them skilfully at cabinet making and fashioning fishing rods and pipes. His abiding love was trout-fishing, and the greatest compliment he could pay a colleague was to invite him to share a fishing trip. He was always cheerful, quizzical and tolerant, with deep prejudices of a red-white-and-blue nature. He was at his best as a raconteur and after-dinner speaker, at which he carried the arts of irrelevance and digression to a high level.

S. J. Butler and T. G. Room.

Walter James Parr

With the death of W. J. Parr, on 21 August 1949, Australian science lost a tireless worker of outstanding ability who had gained world-wide recognition as an authority in his special field. Born in 1894, he entered the Public Service of Victoria in 1911 and served with the Education Department, the Treasury, the Forests Commission and the Mines Department, which he entered in 1932 and from which he retired in 1949 as Assistant Secretary. He fought with distinction in the first world war and was wounded in France.

Early in life he became interested in fossil collecting and later he was induced by the late F. Chapman to take up the study of Foraminifera. His first paper appeared in 1926 and some thirty others followed. His greatest work, to be published posthumously in the near future, is a monograph of Antarctic Foraminifera based on material sent to him by Sir Douglas Mawson.

Parr's work is an example of thorough and painstaking research, controlled by rigid self-discipline. He was as critical towards his own findings as he was kind in his appraisal of the work of others in which his keen mind and deep knowledge of the subject could easily have discovered flaws and weaknesses. He liberally contributed towards the work of his colleagues by giving advice freely and offering specimens from his rich collections without hesitation. Most of the Australian species of Foraminifera described by the late Dr. Cushman in America were sent to him by W. J. Parr. His valuable collections are now being dispersed among various museums and universities in accordance with instructions given by him. The bulk of the material will be deposited in the Commonwealth palaeontological collection in Canberra.

M. F. Glaessner.

News

The Royal Society

The following have been elected as Foreign Members:

Walter Sydney Adams, of Pasadena, distinguished for his contributions to solar and stellar spectroscopy;

Carl Ferdinand Cori, of St. Louis, distinguished for his work on metabolism of carbohydrates in the animal body;

Enrico Fermi, of Chicago, distinguished for his work on theoretical and experimental physics, especially in statistics and the properties of slow neutrons;

Carl Johan Fredrik Skottsberg, of Gothenburg, distinguished for his notable contributions to the study of the geographical distribution and taxonomy of plants.

G. H. Cunningham, F.R.S.

Dr. Cunningham is best known to workers in countries other than New Zealand for his valuable contributions to systematic mycology. In 1931 he published an account of the rust fungi of New Zealand which forms a very important addition to our knowledge of this group. Later he turned his attention to the Gasteromycetes of Australasia and, after publishing a series of critical papers on the members of this group, he produced his book on the *Gasteromycetes of Australasia*, which is a work of the utmost importance to any student of mycology. Although dealing with the Australasian Region, this work is of great value to botanists in other parts of the world because many of the fungi are cosmopolitan.

More recently Dr. Cunningham has been investigating the Australasian Polyporaceae and his contributions in this direction are already important. In New Zealand Dr. Cunningham is perhaps better known for his contributions to plant pathology, particularly in its practical applications to agriculture, and he has a well-deserved prestige in the agricultural community.

Both at Palmerston North and now at the Plant Disease Division at Auckland Dr. Cunningham has gathered round him a group of enthusiastic research workers who owe a great deal to his stimulating encouragement and example.

Walter Burfitt Prize

The Royal Society of New South Wales announces that nominations for the triennial award of the Walter Burfitt Prize should be submitted not later than 31 August 1950. The prize, which consists of a medal and the sum of £75, is awarded to the worker in pure or applied science, resident in Australia or New Zealand, whose papers and other contributions, published during the six years ended 31 December 1949, are deemed of the highest scientific merit. Account is taken only of investigations described for the first time and carried out by the author in this region. The prize may be awarded to two authors working in collaboration. Nominations may be submitted by the scientific societies or the universities, or by scientific workers on their own behalf; or the Royal Society might award the prize to a worker whose name has not been submitted.

The Burfitt Prize was established as a result of a gift by Dr. W. F. Burfitt, later augmented by a gift from Mrs. W. F. Burfitt. It is anticipated that the award will be announced in November 1950.

Harwell Research Fellowships

Applications have been invited for a limited number of Senior and Junior Fellowships, tenable for three years, at the Atomic Energy Research Establishment, Harwell, near Didcot, Berks. Tenure will commence in the autumn of 1950. Candidates must be British subjects and will be expected to show definite evidence of a high standard of research ability. Fellows will be allowed considerable choice of subject within the wide fields of interest of the Establishment.

Junior Fellows should have had at least two years of post-graduate research experience in chemistry, physics, theoretical physics or metallurgy, and should preferably be aged twenty-three to twenty-six. Senior Fellows should have had at least three years of such research and should preferably be aged twenty-six to thirty. Remuneration will be between £475 and £575 a year for Junior Fellows, and between £650 and £750 for Senior Fellows. At the expiry of a Fellowship the holder may be considered for a permanent post at the Establishment if he so desire.

Bertrand Russell

Lord Russell is making a visit of two months to Australia under the auspices of the Australian Institute of International Affairs. The provisional time-table of his visit is as follows:

23 June-8 July, Sydney
8 July-14 July, Brisbane
14 July-20 July, Canberra
20 July-3 August, Melbourne
3 August-9 August, Adelaide
9 August-17 August, Perth
17 August-21 August, Melbourne
21 August-23 August, Sydney.

Three public lectures will be given in Sydney on the theme of 'Obstacles to World Government' (food and population; race; creeds, cultures, ideologies). Two public lectures will be given in Melbourne on the theme 'Living in an Atomic Age'; and one in each of the other capital cities on 'The Ferment in Asia'. Bertrand Russell will conduct seminars on philosophical subjects with a limited attendance of experts at the Universities of Sydney and Melbourne. He will give an address to

the Institute of International Affairs in each city; and on his second visit to Melbourne will participate in the Australian Philosophy Conference.

Australian Journal of Marine and Freshwater Research

A new journal is to be published by the Australian C.S.I.R.O., under the title *Australian Journal of Marine and Freshwater Research*, as a medium for the publication of research papers on the results of original investigations on sea, estuarine, and freshwater fisheries and cognate subjects. It will not appear regularly, but as material becomes available. It is expected that two issues will be published each year. Each issue will cost 7*s.* 6*d.* per copy. Applications for subscription of exchange should be sent to 314 Albert Street, East Melbourne, C.2.

The Editorial Advisory Committee of the Journal comprises G. Humphrey, of the Department of Biochemistry in the University of Sydney; Professor P. D. F. Murray, of the Department of Zoology in the University of Sydney; and H. Thompson, Chief of the Division of Fisheries of the C.S.I.R.O. The Editor will be Dr. N. S. Noble.

Preparation of Papers

The attention of contributors to This JOURNAL is called to the recommendations concerning Authors' Summaries published in the previous issue, pages 136-137. Commencing with Volume 13, in August 1950, articles which are likely to be of interest to abstracting services should be preceded by a summary prepared by the author, in accordance with the *Guide for the Preparation of Synopses*.

The Royal Society of London has published a booklet, entitled *General Notes on the Preparation of Scientific Papers*, which is available from the Society at a cost of 2*s.* 6*d.* sterling.

Conference on Applications of Isotopes

A conference will be held in the Chemistry Department of the University of Melbourne on 14-17 August to provide information for scientists wishing to begin work involving isotopes, and to give opportunities to those already working in the field for formal and informal discussion with other scientists having related interests. The conference will be held under the joint auspices of the University and of the C.S.I.R.O.

The four-day programme will include a number of general lectures on techniques involved in handling and using isotopes, and a number of papers on specific topics. The honorary organizers are: Dr. G. M. Harris, Chemistry Department, University of Melbourne; Dr. T. H. Oddie, Commonwealth X-Ray and Radium Laboratory, University of Melbourne; G. B. Gresford, C.S.I.R.O., 314 Albert Street, C.2, Victoria.

Indo-Pacific Fisheries Council

The second meeting of the Indo-Pacific Fisheries Council was held at Cronulla, N.S.W., from 17 to 28 April 1950. It was attended by thirty-five representatives from eleven member-governments and by representatives of S.C.A.P., U.N.E.S.C.O., and the South Pacific Commission. J. D. F. Hardenberg of Indonesia was elected as Chairman for 1950-1951, and D. V. Villadolid of the Philippines as Vice-Chairman. The Council received a wide range of technical papers relating to all aspects of its programme. Technical Committees were appointed, and *ad hoc* sub-committees were set up.

Technical Committee I, which deals with biology and hydrology, proposed work on the tunas and on the neritic-pelagic group of fish, as a recommendation for succeeding years. It will carry out work on fish culture and on the transplantation of fish. Other work will include planktology, hydrology and taxonomy. Its chairman is W. H. Schuster of Indonesia, and its secretary is G. W. Rayner of Australia.

Technical Committee II, which deals with technology and economics and statistics, will continue its programme of surveying the industries of the Indo-Pacific Region. Its chairman is Claro Martin of the Philippines, and its secretary is C. G. Setter of Australia. One of the Council's major projects consists of a register of the various projects, institutions, vessels and personnel concerned with fisheries work in the Region. Plans were made for the completion of the register and its publication at the earliest opportunity.

National Association of Testing Authorities

Mr. A. E. Dawkins, the General Superintendent of the Defence Research Laboratories, Maribyrnong, has been appointed Chairman of the National Association of Testing Authorities in succession to Sir John Madsen. The newly-appointed Vice-Chairman is Professor D. M. Myers, who was formerly Chief of the C.S.I.R.O. Division of Electrotechnology and who now occupies the Chair of Electrical Engineering in the University of Sydney.

D.S.I.R. Advisory Council

The function of the United Kingdom Advisory Council for Scientific and Industrial Research is to advise upon the policy and activities of the D.S.I.R. Sir Ian Heilbron, D.S.O., Emeritus Professor of the University of London, and Director of Research of the Brewing Industry Research Foundation near Redhill, Surrey, has been appointed Chairman of the Council in succession to Sir Geoffrey Heyworth.

Previous chairmen have been: Sir William McCormick, 1915-1930; Professor V. H. Blackman, 1930; Lord Rutherford of Nelson, O.M., 1930-1937; Lord Riverdale of Sheffield, 1937-1946; Sir Geoffrey Heyworth, 1946-1949.

School in Marine Biology

Through the courtesy of the C.S.I.R.O. Division of Fisheries, the seventh annual School in Marine Biology was held for the week commencing 20 May 1950. The School was attended by eight students and two members of the staff from the Department of Biochemistry, University of Sydney, and by two members of the staff of the Department of Biology, New England University College.

A symposium on the meaning of the term 'biochemistry' was held, at which several visitors participated. Work carried out by the students in the laboratory centered around the following topics:

Mud Metabolism. The polarograph was used to determine the oxygen consumption of samples of muds taken from different depths and localities; the effects of various substrates and inhibitors were also investigated.

Endocrinology. The effects of insulin and adrenaline on invertebrate blood sugar.

Fructose. The distribution and metabolism of fructose in elasmobranch and lamellibranch tissues.

Autolysis. The change in *p*H when body fluids and tissue suspensions were allowed to autolyse.

Chromosin. Residual chromosomes and chromosin were prepared from elasmobranch liver nuclei and examined under the phase-contrast microscope; analyses for nitrogen and phosphorus were also made.

National University

The Chair of Physiology in the John Curtin School of Medical Research has been filled by the appointment of Professor J. C. Eccles, F.R.S., who is at present Professor of Physiology in the University of Otago, Dunedin. Professor Eccles is a graduate of Melbourne, a former Rhodes Scholar and Fellow and Tutor of Magdalen College, Oxford. From 1937 to 1944 he was Director of the Kanematsu Memorial Institute of Pathology in Sydney. He is forty-seven years of age.

The work of Professor Eccles has been mainly in relation to fundamental knowledge of the nervous system. In recent years he has experimented with electronic techniques in the investigation of the nature of muscle response. He will remain at the University of Otago until the construction of buildings at Canberra is further advanced, probably in 1952. A team of Fellows of the Australian National University is expected to join him to work at Dunedin.

The position of Reader in the Sources of Australian History, within the Research School of Social Sciences, has been filled by the appointment of L. F. Fitzhardinge, who is lecturer in Classics in the University of Sydney. For twelve years from 1934 Mr. Fitzhardinge was Historical Research Officer in charge of Australian collections at the Commonwealth National Library. He was Superintendent of the Sydney University Press from 1945 to 1948.

University of Tasmania

Proposals are under consideration for the establishment of a Faculty of Education and a Faculty of Agriculture. The proposed degree of Bachelor of Education would be a four-year course, designed to improve upon the training obtained for teachers through the existing Bachelor's Degree in Arts or Science followed by the Diploma of Education.

The degree of Doctor of Philosophy has been conferred upon D. L. Ingles for a thesis upon 'An Investigation of Organo-Cobalt Compounds'.

Recent appointments include J. A. Cardno as senior lecturer in Psychology; C. S. Soper as lecturer in Statistics and Economics; and L. Milburn as Librarian.

Professor Firth, who has been absent for some months in America on a Carnegie Travelling Grant, is to return in June.

The Council of the University has asked the Professorial Board to report on facilities for extra-mural studies in Tasmania. At present only senior undergraduates are permitted to enrol for external studies, and only then if they are able to give an assurance that they are receiving adequate tutorial assistance.

University of Sydney

A gift of £50,000 has been made to the University by Mr. Martin McIlrath, to be used for research into disease for which the causes remain obscure. It is left entirely to the University authorities to use in whatever way they think best to assist in achieving this end. The Faculty of Medicine has been asked for advice as to how the sum could best be spent.

The J. B. Watt Travelling Scholarship has been awarded to F. A. L. Anet, who graduated B.Sc. with the University Medal in Organic Chemistry. The Barker Graduate Scholarship has been awarded to R. C. Thorne, who graduated B.Sc. with the University Medal in Mathematics.

Recent benefactions include: the third and final instalment of £1000 from the Rural Bank of N.S.W. to assist the work of the Veterinary Clinic and the associated activities of the McGarvie Smith Farm; £250 from the Australian Cream Tartar Co. Pty. Ltd., for the Department of Chemical Engineering; £250 from Lever Associated Enterprises Ltd. for the Department of Chemical Engineering; £100 from Newcastle Chemical Co. Pty. Ltd. for the Department of Chemical Engineering; £100 from Parke Davis & Co. for the Department of Chemical Engineering; a grant from the Rockefeller Foundation to enable the purchase of an electrophorectic apparatus, of value approximately £3000, for use in the Medical

School; £50 from G. C. Halliday for Medical Artistry; £50 from Parke Davis & Co. for the Department of Pharmacology; £950 from the Commonwealth Bank for the Faculty of Agriculture (£750 for rust research, £200 for soil fertility research); £3000 per annum for five years from the Joint Coal Board for research in physiological diseases of coal miners and associated problems; £250 from the C.S.I.R.O. for a sheep genetic survey of northern N.S.W.; £45. 10*s*. from G. Donkin for the Kimberley Scientific (Anthropological) Expedition; £50 from W. G. Law for soil analysis research; books and instruments valued at £100 belonging to the late Dr. Lawson for the Department of Physiology; and donations totalling over £1796 from nine other sources.

University of Melbourne

The Vice-Chancellor, Sir John Medley, has formally expressed his wish to retire from office as at 30 June 1951, when he will be sixty years of age. He believes that, after his twelve years of difficult university circumstances, he will have exhausted his physical resources and the University will need a younger man.

Professors Paton and Turner have been elected to the Council of the University to represent the professorial staff. Professor Gibson succeeds Professor Paton as Chairman of the Professorial Board. Professor Moorhouse has been elected Dean of Engineering in place of Professor Matheson, who is leaving to take up an appointment at Manchester. Miss J. Millis is resigning her senior lectureship in Biochemistry. A. S. Watt, of Cambridge, has taken up his duties as exchange senior lecturer in Botany.

The degree of Doctor of Veterinary Science has been conferred upon D. Murname, of the C.S.I.R.O. Division of Animal Health. The degree of Doctor of Philosophy has been conferred upon L. J. Ray for post-graduate research in neuro-anatomy, on W. B. Lasich for nuclear physics, on J. R. Prescott for cosmic rays.

University Travelling Scholarships have been awarded to P. Herbst (Philosophy) who will read for the D.Phil. degree at Oxford, to C. P. Rundle (Physics), who will work under Professor H. S. W. Massey in the University of London, and to D. Gillam (Chemistry), who will work at Uppsala. A re-award for a further year has been made to Murray Kemp, who is reading for the Ph.D. degree at the Johns Hopkins University.

The first graduate student of the Department of Mathematical Statistics is J. H. Bennett, who has been awarded the Nanson Prize and a National University Scholarship in the John Curtin School of Medical Science. Although without training in medicine, he has been successful in complex research in the field of genetico-statistics. He is leaving to work in Cambridge under Professor R. Fisher.

The Faculty of Science has approved the giving of a short course in specialized microscopy to research students, staff and technical assistants. The course will be given by E. Matthaei, the officer-in-charge of Faculty Workshops.

There are at present 350 full-time or part-time overseas students in the University, and 39 studying single subjects. They comprise 11 from Africa (Egypt 8), 36 from North America (U.S.A. 32), 137 from Asia (China 9, Ceylon 16, India 19, Malaya 41, Indonesia 13, Siam 9, Singapore 20), 144 from Europe (Austria 10, Czechoslovakia 10, Germany 25, Hungary 12, Latvia 17, Poland 36), 12 from New Zealand, one from Fiji. Of the single-subject students, nine are from Germany, four from Poland and four from Malaya.

Recent benefactions include £200 from Burroughs Wellcome & Co. (Aust.) Ltd. and £20 from J. L. Brown & Co. Pty. Ltd. for the Bioassay Fund; £400 from Nicholas Pty. Ltd. for salary for assay work in the Biochemistry Department; £250 from Nicholas Pty. Ltd. and £150 from Tromax Pty. Ltd. for research in the Physiology Department; £200 from Burroughs Wellcome & Co. Ltd. towards the cost of assay work in Pharmacology; £50 from H. J. Heinz Co. Pty. Ltd. for agricultural research; £1000 from S. Kosky to provide a prize and library books in Political Science; £30 from the Mining and Metallurgical Bursaries Fund; and sums totalling £1288 from eleven other donors.

The Syme Prize

The Syme Prize for 1950 has been awarded to C. Teichert, senior lecturer in Geology in the University of Melbourne, for his papers on the stratigraphy and palaeontology of Western Australia and his work on the origin and evolution of coral reefs. Dr. Teichert's systematic investigations into the distribution and correlation of sedimentary rocks in Western Australia, and the history of the basins, were begun in 1938 and have led to a greater understanding of the geological history of the State since Cambrian times. They have stimulated the hope of future oil discoveries in the Kimberley District.

The Syme Prize is of the value of £125, together with a bronze medal, and was first awarded in 1906. It is for annual competition among Australian scientists in any field of research.

University of Adelaide

The new Chair of Mathematical Physics has been filled by the appointment of H. S. Green, at the age of twenty-nine years. Professor Green graduated from the Imperial College of Science in London in 1941 and then served for four years as meteorologist with the Royal Air Force. From 1945 to 1949 he worked with Max Born at the University of Edinburgh, on an Imperial Chemical Industries Fellowship. He is at present at the Princeton Institute for

Advanced Study and will fulfil an engagement as visiting professor at the Dublin Institute of Advanced Studies before he comes to Adelaide in July or August 1951.

The Chair of Economics has been filled by the appointment of P. H. Karmel, senior lecturer in Economics in the University of Melbourne.

Dr. W. G. K. Duncan, the Director of Tutorial Classes in the University of Sydney, has been appointed to the Chair of History. Professor Duncan is a graduate of Sydney. He spent four years in London studying political science and sociology, and two years at American universities, with a Commonwealth Fellowship, studying problems of population and migration.

Dr. Martin F. Glaessner, who has been appointed senior lecturer in Palaeontology, is a Doctor of Laws and Philosophy of the University of Vienna and D.Sc. of Melbourne. He lectured in Geology in the University of Moscow until 1937, when he was appointed geologist on the staff of the Anglo-Iranian Oil Co. For some years he has been engaged in the exploration of petroleum-prospecting areas in New Guinea and Papua. His book, *Principles of Micropalaeontology*, was published by Melbourne University Press in 1945.

The following appointments have also been made: H. H. G. Jellenck (London and Cambridge) as senior lecturer in Inorganic and Physical Chemistry; B. C. Rennie (Cambridge) as senior lecturer in Mathematics; S. G. Tomlin (London) as senior lecturer in Physics; J. P. Morgan as Reader in Mining Engineering; R. W. F. Tait (Birmingham) as senior lecturer in Chemical Engineering; G. Sved (Budapest) as senior lecturer in Civil Engineering; R. W. Crompton and W. G. Elford as lecturers in Physics; Nancy Atkinson (Melbourne) as Reader-in-Charge of Bacteriology; D. R. Bowes (Adelaide and London) as lecturer in Geology. All but the last two are new positions.

University of Queensland

Professor S. A. Prentice has been appointed to the Chair of Electrical Engineering, coming from the position of Electrical Design Engineer in the State Electricity Commission of Victoria. The Chair of Mining Engineering has been filled by the appointment of Professor F. T. M. White, who was previously in H.M. Colonial Mines Service in Fiji and Malaya.

Other appointments include G. L. Wilson, a former Rhodes Scholar of Queensland, as lecturer in Botany; A. R. Endine as assistant lecturer in Zoology; Mrs. P. W. V. Macfarlane as temporary assistant lecturer in Zoology.

University of Western Australia

Following difficulties encountered in the establishment of instruction in the full medical course, the Senate is considering the establishment of post-graduate Chairs of Medicine and Clinical Pathology.

The first degrees of Bachelor of Education, for which a four-year course was introduced in 1948, were conferred at this year's graduation ceremony.

Personal

Dr. Marjorie J. Mathieson, lecturer in Botany in the University of Melbourne, has returned from Cambridge after going abroad in 1947 as a British Council scholar. While at Cambridge she was awarded a Fellowship of the International Federation of University Women. L. W. Shears, who has been awarded an Imperial Relations Trust Fellowship, and recently received a conferring of the three degrees of B.A., B.Com. and B.Ed. from the University of Melbourne, is going to London to study for the Ph.D. degree in Education. Professor Leslie A. Osborn, a graduate of Melbourne, has been appointed Head of the Department of Psychiatry in the University of Buffalo in the State of New York.

Dr. N. H. Fairley of Melbourne has been awarded the Manson Medal for Tropical Medicine by the Royal Society in Tropical Medicine and Hygiene. Professor J. A. Prescott, Director of the Waite Agricultural Institute in the University of Adelaide, and Chief of the C.S.I.R.O. Division of Soils until 1947, has been awarded the 1950 Medal of the Australian Institute of Agricultural Science. His work on the classification and mapping of soils was first completed in 1931 and was revised in 1944. He is now engaged in mapping Australian climatic regions and their adaptability for land use. (An article by J. A. Prescott and J. K. Taylor on the classification and mapping of Australian soils appears on page 92 of the current volume of This JOURNAL.)

The conference on the Structure of the Atmosphere, which is to be held at Pennsylvania State College, U.S.A., in July, will be attended by Professor L. G. H. Huxley of the University of Adelaide, Dr. R. v. d. R. Woolley of the Commonwealth Observatory, and Dr. D. F. Martyn, F.R.S., of the C.S.I.R.O.

Dr. W. J. Simmonds has recently taken up his appointment as a Senior Fellow on the research staff of the Kanematsu Memorial Institute of Pathology of Sydney Hospital. Dr. Simmonds went abroad from the Department of Pathology of the University of Queensland in 1946, on a Nuffield Dominions Fellowship. This he held in the Department of Physiology of the University of Oxford until his return to Australia this year.

The Scientific Societies

Royal Society of New South Wales

April: S. E. Livingstone, R. A. Plowman and J. Sorensen, Studies in the chemistry of palladium complexes, I. The reaction of potassium chloropalladite-II with o-methyl mercapto benzoic acid.

R. A. Plowman, Studies in the chemistry of palladium complexes, II. Some properties of tetrammine platinum-II fluorides; III. Oxidation of the tetrammine platinum-II fluorides.

May: R. C. L. Bosworth, The five properties concerned in the transport of the active corrodant agent.
G. K. Hughes and E. Ritchie, The mechanism of the Fischer indole synthesis.
A. H. Voisey, The Permian rocks of the Manning-Macleay Province, N.S.W.
C. J. Magee (lecture), Moulds and mildews.
P. M. Rountree (exhibit), The Bourdillon air sampler.

June: F. P. Dwyer, N. A. Gibson and E. C. Gyarfas, The chemistry of osmium, IV. The resolution of the tris-o,phenanthroline osmium-II ion.
D. S. Simonett, On the grading of sand dunes near Castlereagh, N.S.W.
H. B. Carter (lecture), Fleece growth and problems of climatic adaptation in sheep.
W. R. Browne, On the geology of the Mittagong-Bowral District, N.S.W.

Papua and New Guinea Scientific Society

April: D. Conley, The fisheries survey in Papua and New Guinea.

Royal Society of Tasmania

June: H. L. Greener, Educating the whole man.

Royal Society of Queensland

April: Owen Jones (lecture), the Use of seismographs in the detection of cyclones.

May: M. F. Hickey (lecture), Some aspects of congenital abnormalities.
A. L. Reiman (lecture), Electron gases.
I. M. Mackerras (lecture), The Marine Biological Station of the Great Barrier Reef Committee.

Royal Society of Western Australia

May: M. H. Johnstone, Geology of the Hammersley Siding Area.
M. Lukis (lecture), The early development of the Avon Valley.

Royal Society of South Australia

May: H. M. Cooper, Stone implements on a mangrove swamp at South Glenelg.
D. Mawson, Basaltic lavas of the Balleny Islands, A.N.A.R. Expedition Report.

June: T. H. Johnston and S. J. Edmonds, Australian Acanthocephala, VIII.
P. S. Hossfeld, Late Cainozoic history of south-eastern South Australia.

Royal Society of Victoria

May: A. A. Wilcock, Potential evapotranspiration —A simplification of Thornthwaite's method.
F. Loewe (lecture), Expedition to the Antarctic.

June: J. S. Turner (lecture), Biological field stations and national parks abroad.

Victorian Society of Pathology and Experimental Medicine

May: G. S. Christie, Pulmonary and other extra-articular lesions in rheumatoid arthritis.
H. Barker, Carbon tetrachloride poisoning and the nucleic acid content of guinea pig liver.
M. M. Wilson, Demonstration and description of sheet aluminium cages for experimental animals.
D. B. Rosenthal (demonstration), Lung slices—A new technique for the study of lung pathology.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

An Unusual Species of Mycobacterium Isolated from a Chronic Cutaneous Ulcer

On 13 April 1948, a male patient, aged forty years, suffering with chronic ulceration of the skin immediately proximal to the lateral malleolus of the left leg, was referred to this School for laboratory investigation.

The ulcer had developed some two years previously and had proved refractory to treatment. At the time of examination, the lesion consisted of six discrete areas of ulceration, with undermined edges, separated by slender epithelial bridges. Elsewhere, there were dense cicatrization and extensive pigmentation. Direct smears from the lesion showed acid-alcohol-fast mycobacteria, occurring singly and in bundles.

The organisms were isolated in culture on egg-yolk medium. On primary isolation, the optimum temperature for growth was in the vicinity of 30°C., and the organisms failed to grow at 37°C., or at room temperature (average 20°C.). In both cultural requirements and colony appearances, the mycobacteria closely resembled those described by McCallum, Tolhurst, Buckle and Sissons (1948).

Infection was established and propagated by serial passage in mice, rats and phalangers (*Trichosurus vulpecula*) (Bolliger *et al.*, 1950). The mycobacteria were not pathogenic to guinea-pigs, blue-tongued lizards (*Tiliqua scincoides*) or domestic fowls.

The mycobacteria were sensitive, *in vitro*, to para-amino-salicylic acid, streptomycin, and sulphetrone.

Histo-pathological observations were made on biopsy material from the patient and tissue from infected animals. These findings, together with the clinical record of the patient, will be reported in a subsequent publication.

B. R. V. Forbes,
W. B. Kirkland,
J. S. Wannan.

School of Public Health
and Tropical Medicine,
University Grounds,
Sydney.
16 May 1950.

References

BOLLIGER, A., FORBES, B. R. V., and KIRKLAND, W. B. (1950): *Aust. J. Science*, *12*, 146.
MACCALLUM, P., TOLHURST, JEAN C., BUCKLE, G., and SISSONS, H. A. (1948): *J. Path. and Bacteriology*, *60*, 93.

A Note on the Iodination of Phenols

The work reported in this note was carried out some time ago in an attempt to derive an accurate quantitative method for the determination of mixtures of phenols. The method showed promise and it had been hoped that the technique could be improved to increase the reproducibility; but other developments render it most unlikely that it will be possible to carry out any further work on this problem. It was felt, however, that the results obtained were of sufficient interest to be placed on record.

A literature survey revealed a large number of modifications of the original bromometric (Koppeschaar, 1876) and iodometric (Messinger and Vortman, 1890) methods; acid or alkali concentration, reaction time, temperature and excess of the reagent being the main variables described. The iodometric method appeared the more suitable for the problem on hand, so it was examined.

Preliminary work showed that phenols were iodinated by hypoiodite or nascent iodine but not by molecular iodine or iodate. The most promising method involved the formation of the hypoiodite *in situ* by the addition of potassium tri-iodide solution to the hot alkaline phenate solution as follows:

Fifty ml. water, 5 ml. 2N sodium hydroxide solution and 5-10 ml. of 0·025M sodium phenate solution were heated to approximately 90°C, after which 20-60 ml. of 0·1N iodine solution were added. After shaking, the mixture was allowed to stand for ten minutes before cooling under the tap and acidifying with 5N hydrochloric acid. The excess iodine was back-titrated with thiosulphate to starch end-point.

Some methods specify filtration of the alkaline solution and acidification of an aliquot; but this was found to be unnecessary as, with starch, a good clear end-point was obtained in the presence of the iodinated phenols.

The amount of iodine absorbed by various phenols was determined by this method. It was found that an excess of iodine was required in order to obtain relatively constant results, this excess being at least 50% of the amount reacted. The reproducibility of the results was usually within 5%, the results obtained being presented in Table 1 as the mols of iodine absorbed per mol of the phenol.

In a few cases substitution appeared to be complete, while in others it was only partial. With *p*-nitro phenol no substitution was observed (which could be expected), while some decarboxylation and substitution of salicylic acid appears to have occurred. Phenolphthalein, resorcinol and catechol absorbed considerably more than the theoretical amount of iodine.

Table 1.
Iodination of Phenols.

Phenol	*% Excess I_2 Added*	*Mols I_2 Used*	*Per Mol Phenol for Max. (Normal) Subs.*
Phenol	50-400	2·20-2·30	3
o-Cresol	100-400	2·00-2·10	2
m-Cresol	80-200	2·60-2·80	3
p-Chlor. *m*-Cresol	100-300	1·80-1·95	2
sym. m-xylenol	20-150	3·00-3·05	3
Thymol	100-400	1·98-2·10	2
p-Nitro phenol	To 200	nil	2
Salicylic acid	80-400	2·00-2·50	2
Phenolphthalein	50-200	7·90-8·10	4
Fluorescein	100-200	0·10-1·90	4
α-Naphthol	(Unsuitable as a solution, went very dark.)		
β-Naphthol	200-800	1·50-1·70	2
8-Hydroxyquinoline	100-1000	1·50-1·70	2
Catechol	100-400	5·00-5·70	4
Hydroquinone	100-300	3·60-3·70	4
Resorcinol	150-300	6·10-6·40	3

Complete substitution of the phenol residues of the phenolphthalein could possibly take place because of the activation by the keto form, in which case the maximum absorption would be eight mols of iodine per mol of phenolphthalein, which agrees with the observed absorption.

Oxidation of the catechol to the ortho quinone could explain the absorption of a further one molecule of iodine over that required for substitution. No simple explanation can be suggested for the high iodine consumption by resorcinol.

Acknowledgements

The authors wish to acknowledge with thanks the assistance of E. W. Rooke in carrying out the work, and the permission granted by the management of National Oil Pty. Ltd. for publication of this note.

GEO. E. MAPSTONE.
National Oil Pty. Ltd.,
Glen Davis.

P. BECKMANN.
Technical College,
Wollongong.
June 1950.

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KOPPESCHAAR (1876): *Anal. Chem.*, *15*, 233.
MESSINGER and VORTMAN (1890): *Ber. deutsch Chem. Gess.*, *23*, 2753.

Addendum

A Modified Form of the Allen Hydrogen Arc

The following reference should be added to the letter under the above title, by T. M. DUNN, R. A. DURIE and T. IREDALE, published in This JOURNAL, *12*, 143-4 (February 1950).

Reference

ALLEN, A. J. (1941): *J. Opt. Soc. Amer.*, *31*, 268.

Reviews

Agriculture

ADVANCES IN AGRONOMY. Edited by A. G. Norman. (New York: Academic Press Inc., 1949. 439 pp.) Price, $7.50.

Because of the extent of the literature recording recent experiments, it is difficult, if not impossible, for most scientific workers to keep abreast of developments except in their own special fields. One continually feels the need of some work or book to record progress in a concise form. *Advances in Agronomy* has set out to do this and has, in its first volume, succeeded to a remarkable degree.

Volume I contains chapters on Plant Growth on Saline and Alkali Soils; New Fertilizers and Fertilizer Practices; Soybeans; The Clay Minerals in Soils; Alfalfa Improvement; Soil Micro-organisms and Plant Roots; Weed Control; Boron in Soils and Crops; Potato Production; Fixation of Soil Phosphorus.

Each chapter has been written by a leading worker or workers in the field. It reviews recent developments against a background of established and accepted information and brings together, in a well-coordinated plan, the present knowledge of the subject. For example, the chapter on 'New Fertilizers and Fertilizer Practices' deals with phosphate, phosphorus-nitrogen, nitrogen, potash and mixed fertilizers; the use of these; methods of application, etc.; while the chapter on 'Potato Production' covers the breeding and improvement of varieties, rotations, effect of fertilizers and minor elements, yield, insect and disease control. A complete list of references is given at the end of each chapter.

J. R. A. MCMILLAN.

Biochemistry

OUTLINES OF BIOCHEMISTRY. By the late R. A. Gortner. Third edition, edited by R. A. Gortner, Jr., and W. A. Gortner. (New York: John Wiley; London: Chapman and Hall, 1949. xvi + 1078 pp.) Price, $7.50.

The third edition of this well-known book has undergone extensive modifications through the co-operation of several prominent scientists: S. I. Aronovsky, P. D. Boyer, D. R. Briggs, H. B. Bull, G. O. Burr, W. F. Geddes, R. A. Gortner, Jr., W. A. Gortner, H. O. Halvorson, W. M. Sandstrom, T. Schoch, J. J. Williaman.

The book is divided into six sections arranged in this manner: I. Colloids, 10 chapters, 274 pages; II. Proteins, 11 chapters, 240 pages; III. Carbohydrates and related substances, 8 chapters, 248 pages; IV. Lipids and Essential Oils, 4 chapters, 80 pages; V. Plant Pigments, 2 chapters, 40 pages; VI. Biochemical Regulators, 3 chapters, 132 pages.

The editors have tried to keep the aims and approach to the subject matter as much as possible like those of the original author. Such a sentimental approach to a scientific presentation is open to criticism, yet it must be admitted that in comparison with other general textbooks this is an outstanding contribution. In view of certain obvious deficiencies, however, it is pertinent to consider whether one volume is sufficient to cover the formidable array of material dealt with in biochemistry. The scope of such a hybrid science is almost limitless. In fact, limitations are imposed normally by the outlook of the individual worker.

It was essential in earlier presentations of biological subjects to emphasize the importance of colloidal systems, but now that this aspect has become firmly established in the physico-chemical field of macromolecules there seems little reason for such detailed discussion if students take parallel courses in general chemistry. Several pages, for example, are devoted to the preparation of inorganic colloids; yet, in distinct contrast, only 132 pages are devoted to the vitamins, hormones and enzymes. The warning of Sørensen (1917)* indicated early the danger of using polydisperse, lyophobic colloids as models for lyophilic particles of specific molecular dimensions, such as the proteins.

The major portion of the book has been prepared by agricultural biochemists, and this fact, together with the editorial decision to omit details relating to medical biochemistry, are sufficient to explain and excuse the bias towards plant materials. In illustration: lignin, tannins and essential oils (40 pages) receive relatively more attention than hormones and enzymes (71 pages). Against this criticism we must admit the past neglect of plant biochemistry by other authors. The dynamic approach is not emphasized, as might be concluded from the fact that intermediate metabolism is covered in 92 pages of direct reference.

It is unfortunate that animal pigments have received only scant and somewhat inaccurate commentary. For example: cytochrome oxidase yielding mesoporphyrin; hæmerythrin containing a porphyrin residue; hæmocyanin possessing a copper content of 0·33-0·38%.

The standard of the printing and proofreading must be given full credit. The reviewer considers his detection of one typographical error—Trumbull instead of Turnbull's blue—a personal triumph. This revised work gives a strong indication that a future edition should be possible, in which all major aspects of biochemistry are presented without such emphasis on either the original author's approach or the interests of the present contributors.

W. A. RAWLINSON.

* SØRENSEN, S. P. L. (1917): *Compt. rend. trav. lab. Carlsberg*, 12.

Botany

PLANT AND SOIL WATER RELATIONSHIPS. By Paul J. Kramer. (New York: McGraw Hill, 1949. 347 pp., 50 text-figs., 7 tables. 6″ × 9¼″.) Price, $4.50.

This book is purposely designed to meet the overall needs of botanists, agricultural scientists and foresters, and must consequently be regarded as a general introduction to the fundamental phenomena of the relations between plants and soil water, aiming at giving a general understanding of the subject to the non-specialist worker and at the same time introducing the specialist to the phenomena in the fields cognate to his own narrower specialty. In its general purpose it succeeds admirably and it can be recommended to both specialists and non-specialists alike.

After a chapter devoted to a historical introduction, three chapters (84 pages in all) are devoted to soil moisture, its availability to plants, its measurement and control. All of this is familiar ground to the soil scientist and much of the ground is already covered in such standard texts as those of Baver, Keen, Lyon and Buckman, and Russell. It is convenient, however, to have it so well summarized in these pages. At the end of this section there are some useful practical hints on the control of soil moisture in pot experiments and in glasshouse and field practice. The next two chapters deal with the structure and growth of roots and the factors affecting their development, and a further chapter deals with exudation phenomena associated with root and stem pressures as exemplified by the 'flow and sap' and guttation.

The final four chapters are concerned with actual absorption of water by the plants, the processes concerned and the factors affecting these processes; with the absorption of solutes and the internal water deficits in plants caused by differences in the rates of absorption and transpiration. An important section in these chapters deals with the nature of the absorption process and the factors affecting the absorption of solutes. This is effectively summarized in the author's own words:

> It is generally agreed that the absorption of nutrient salts by plants depends primarily on the ability of the cells of the roots to accumulate them, and this requires the expenditure of energy. Much attention has been given to the nature of this accumulation process, and considerable is known about the factors affecting it, although its exact mechanism is still unknown. Practically all workers agree that energy is expended by the cells in bringing about a transfer of solutes across the cytoplasmic membranes against a concentration gradient, but they do not agree on the manner in which it is expended.

This is very familiar to the plant physiologist —surely there is a challenge here for the physical chemist.

There is an extensive bibliography covering 46 pages, referring principally to American work. As is to be expected from the author's own interest, many of the examples quoted deal with trees, both of the orchard and the forest.

J. A. PRESCOTT.

Chemistry

PHYSICS AND CHEMISTRY OF CELLULOSE FIBRES, WITH PARTICULAR REFERENCE TO RAYON. By P. H. Hermans. Polymer Series, No. 2. (New York-Amsterdam - London - Brussels: Elsevier, 1949. 534 + 22 pp., 225 text-figs., 58 tables. 6″ × 9½″.) Price, $9.50.

This book by Dr. P. H. Hermans (Director of the Institute for Cellulose Research of the Algemeene Kunstzijde Unie and affiliated companies, Utrecht, Netherlands) is an excellent contribution to the chemistry and physics of native and regenerated cellulose and would be a valuable acquisition to any library.

The author, by virtue of his long association with the more fundamental aspects of the viscose rayon industry, has very successfully collated the empirical features of rayon technology with modern developments of the physics and physical chemistry of high polymers, especially of cellulose. The book is divided into three parts, viz.:

PART I. CONSTITUTION; CRYSTALLINITY; MICELLAR STRUCTURE; MOLECULAR WEIGHT; CHEMICAL BEHAVIOUR AND DISPERSION OF CELLULOSE.

PART II. GENERAL PROPERTIES OF CELLULOSE IN THE FORM OF FIBRES; MORPHOLOGY AND MICRO-STRUCTURE; PHYSICAL AND CHEMICAL BEHAVIOUR OF CELLULOSE FIBRES.

PART III: ARTIFICIAL CELLULOSE FIBRES.

Although emphasis has been placed on those factors which, directly or indirectly, are related to the viscose rayon process, Parts I and II of the book contain much which is of interest to those engaged in any field of fundamental research on cellulose.

Part I gives a fairly detailed picture of the general molecular structure of cellulose and, in particular, of cellulose modifications I and II and of alkali cellulose. The micellar theory and its modifications are critically discussed. A very good coverage is given of the various methods for the determination of chain length. A most informative chapter on the chemical reactions and breakdown of chain molecules is provided. Finally, the analogy between native and regenerated cellulose is discussed.

Great interest, however, attaches to Parts II and III of the book, in which controversial aspects of the subject-matter are discussed and the author's conclusions are stated. Such a mode of presentation makes these sections both valuable and stimulating. In Part II, methods of structural investigation of cellulose are described and much of the already pub-

lished work of Dr. Hermans and his colleagues is placed in perspective against that of other investigators.

Much space has wisely been devoted to the processes of solution and swelling, which have not, until recently, been clearly understood. These processes are considered in the light of the latest physico-chemical concepts, and in this way the now obsolete colloid-chemical terminology is avoided. New data are presented, and the author's conscientious attempt to account for the morphological changes in fibres during chemical and physical treatments, in terms of their micellar and molecular constitution, is welcome and greatly simplifies the discussion. In view of modern trends, the chapter on mechanical properties is full of interest because of the application of stress-strain analyses.

Part III deals more specifically with the viscose rayon process. Apart from Chapter II, in which a very brief account is given of the process of viscose formation, the author presumes that the chemistry and technological aspects of the rayon process are known, and he makes a strictly fundamental approach in offering theoretical explanations of the various stages of the rayon process and of factors affecting the properties of rayon. For this purpose, Parts I and II of the book provide an excellent basis.

Instances of translation difficulties are surprisingly few, as also are typographical errors. The fact as stated by the author that some English and non-European literature was not available to him when the book was written will not appear as a serious defect to English-speaking readers, because any such weakness which is apparent is adequately compensated by the author's detailed documentation of European literature not readily accessible, especially in Australia.

The book is admirably produced and well illustrated and can be recommended with confidence to all who are interested in fundamental problems of cellulose research and of rayon manufacture.

W. E. Cohen.
A. B. Wardrop.

Food Science

Advances in Food Research. Volume II. Edited by E. M. Mrak and G. F. Stewart. (New York: Academic Press, 1949. 558 pp., 47 text-figs., numerous tables and plates. 9¼″ × 6″.) Price, $8.50.

The second volume of this series maintains the excellent standard set by the first. The selection of subjects and authors and the format of the volume reflect great credit on the editors.

The review of 'The Chemistry of Fruit and Vegetable Flavours' by J. G. Kirchner shows how little is known of the main flavour constituents of common foodstuffs. It is not surprising, therefore, that the research worker in the fields of food preservation and processing has frequently to resort to methods of analysis of foods and rates of deterioration based on sensory difference tests. The review of these methods by Mildred Boggs and Helen Hanson clearly shows that the so-called tasting tests can give fairly accurate results, provided that a number of suitable precautions are taken.

C. R. Stumbo's review of 'Thermobacteriology as Applied to Food Processing' gives in some detail the fundamental basis of the methods for evaluating heat processes, but a rather more searching analysis of the factors influencing the heat resistance of bacteria in foods would have added materially to the value of Stumbo's contribution.

A number of the quaternary ammonium compounds appear to meet a large proportion of the requirements for an ideal microbicide, and C. G. Dunn's exhaustive review shows how valuable they are becoming in many food industries. Despite a considerable amount of bacteriological work, there are still few fundamental data on the mechanism of the action of these compounds.

'The Spoilage of Fish and Its Preservation by Chilling', by G. A. Reay and J. M. Shewan, is a model of clarity and critical appraisal of recent scientific progress in this field. For a number of years this review will probably be a standard reference work on fish preservation.

The procedures of ion exchange will probably be applied much more widely in several food industries, particularly sugar refining, and will create radical changes in current techniques. G. E. Felton indicates the potentialities of the methods and gives in some detail their application in the recovery of citric acid and sugar syrups from pineapple wastes, and in the purification of beet sugar.

Useful reviews are included on 'The Pharmacology of D.D.T.', by A. J. Lehman, and 'Histological Changes Induced in Fruits and Vegetables by Processing', by T. E. Weier and C. R. Stocking. The volume concludes with a very long discussion (pp. 399-520), by E. Seltzer and J. T. Settelmeyer, on the chemical engineering aspects of the spray drying of foods.

Advances in Food Research will be almost as essential in food laboratories as are tables of physical and chemical constants.

J. R. Vickery.

Organic Chemistry

Organic Chemistry. By Paul Karrer. Translated by A. J. Mee. Fourth edition (Eleventh German edition), revised by H. V. Simon and N. G. Bisset. (Amsterdam: Elsevier; London: Cleaver-Hume, 1950. 983 + xxi pp. 6¼″ × 9¾″.) English price, £2. 17*s*. 6*d*.

In the preface to the first English edition of his textbook, Professor Karrer stated that his

aim was 'to provide students with a textbook of organic chemistry of medium size which would give them a survey of the ever-increasing body of facts'. He also pointed out that 'a textbook of moderate size must inevitably be limited in certain directions in order that other questions may be dealt with more fully', and that in his book 'the chemistry of naturally-occurring substances and biochemical topics have been particularly emphasized'. This policy led even to a clear statement of the salient features of Robinson's theory of the phytochemical synthesis of alkaloids; unusual in a textbook, but of such value that, of the reviewer's personal knowledge, it formed the stimulant which led to some recent brilliant researches at Sydney culminating in the synthesis of such alkaloids as cuscohygrine and sparteine. Because of that alone, Karrer's textbook must be adjudged worth-while!

The average student, however, judges a textbook by other standards such as clarity of exposition, factual accuracy and breadth, up-to-dateness and good printing. Some measure of the value of the present textbook can then be obtained by consideration of the fact that this present fourth English edition is translated from the eleventh German edition, and is published only four years after the appearance of the second English edition.

The new volume, which is most handsome in appearance, well printed and bound, contains over 900 pages of text. Much of the standard textbook information of previous editions is retained unaltered, whilst on the other hand the interpretations of many reactions and structures have been modernized in conformity with current theory. The reviewer has often felt that not quite so many reactions of the different classes of organic compounds are discussed in 'Karrer' as must be considered in a detailed, systematic course of organic chemistry, and that the book falls short in this respect—that it is to wide and too shallow rather than narrow and deep. At the same time he freely admits that the inclusion of so much more factual information would probably necessitate an extra volume! This present fourth edition has already had added to it as new material some descriptions of organic silicon compounds, diacyl peroxides and per-acids, and organic compounds containing isotopic carbon and nitrogen. A notable omission seems to be a short co-ordinated chapter on the substances generally grouped as 'high polymers'. Further, the description of acetylenic compounds should be re-written to include the important recent German, English and American work on these substances.

Taken all in all, this fourth edition of Karrer represents a most useful textbook at a price which, today, must be considered quite moderate. The student who can assimilate all the information it contains will be an educated organic chemist.

F. LIONS.

ELECTRONIC INTERPRETATIONS OF ORGANIC CHEMISTRY. By A. E. Remick. (New York: John Wiley; London: Chapman and Hall, 1949.) Price, $6.00.

This is a second edition of a book which has proved to be very popular among students and teachers since it appeared some seven years ago. There has been an increase of nearly one hundred pages, which have been devoted mainly to further studies of reaction mechanisms and to contributions from the field of stereochemistry.

Books on the subject have to stand comparison with the many that have appeared during the last few years. Different aspects of the quickly changing views are naturally given different stress by the various authors. In addition, the advent of the molecular orbital treatment has made the review of a book containing only resonance views more difficult: it would seem that a third edition will probably be necessary after a shorter lapse of time than between the first and second.

Despite the above criticism, the book again appeals as a good introduction, particularly from the English viewpoint. The retention of the historical section is appreciated; too often this aspect is overlooked by both author and reader. Having used the first edition as a basis for discussion with senior students of organic chemistry, the reviewer can congratulate the author on his easily readable style: such phrases as 'the task of tracing . . . the author will *cheerfully* leave to future historians' show a human touch. There are some misprints and some mistakes, but they are few.

A more complete account of a much wider range of reaction mechanisms is awaited by those interested in and responsible for the teaching of this subject; but in the meantime this book is a stimulating and useful introduction, especially to those who have not an advanced mathematical background.

G. K. HUGHES.

Paints

ORGANIC COATINGS IN THEORY AND PRACTICE. By A. V. Blom. Elsevier's Polymer Series, No. 6. (Amsterdam: Elsevier; London: Cleaver-Hume, 1949. 298 + xii pp., 121 text-figs., 82 tables. 6½" × 10".) Price, $6.00.

The announcement by the publishers some time ago that a book was in preparation by the Swiss authority A. V. Blom, dealing with the theory and practice of surface coatings, was greeted with considerable interest and appreciation by paint technologists in Australia. Blom's previous authoritative writings in the field were well known here, and this fact may in part be the reason for the disappointment that was felt when copies of the book arrived. Within a space of 298 pages, Blom attempts to deal with all aspects of paint, ranging from the fundamental problems

of film formation of drying oils and resins, to the manufacture, application and testing of surface coatings. A treatise of such length could be only very sketchy, and while this in itself should not detract from the value of the book, it does not allow for the inclusion of the wide range of data and theory necessary for such a survey. Unfortunately, too, the author does not seem to have decided whether to write for the young student or for the scientist familiar with the subject. Thus the book has become a mixture of very elementary material and material comprehensible only to specialists.

In general, there appears to be a lack of logical development throughout, rendering the reading of the book troublesome and tiring. This is still further aggravated by the apparent language difficulties experienced by the author. Proper correction by an English translator conversant with the scientific terms, prior to printing, would have been well worth while. On page 118 we read: 'The isothiocyanates react in a similar manner, but their repulsive smell is a contraindication to their commercial application'. Terms such as 'plastifiers', 'plastification', 'thermically', 'hydrocarbonic', should not be found in a scientific publication.

The mode of expression used in many instances is, to say the least, cumbersome. For instance, on page 24 the author, wishing to describe certain phenomena observable under polarized light, states: 'This phenomenon becomes observable when strips of polymeric material are stretched between crossed Nicols'. Furthermore, many specialized scientific terms are used throughout the book; these could have been replaced by more common terms, so rendering the text more readable.

In a number of instances it is difficult to form a clear picture of what the author wishes to convey. As an example may be quoted his description, on page 38, of the 'running' of copals. At first it is stated that the heating between 300°C and 330°C results in depolymerization; a few lines further down the statement is made that 'at the same time, however, the molecular weight rises to about double its previous value'. Some clarification is most certainly needed. Unfortunately, also, a number of mistakes have been noted. On page 53, where dehydrated castor oil is described, it is stated that '. . . this oil contains two conjugated double bonds in each fatty acid chain'. It is a well known fact that in dehydrated castor oil only a relatively small proportion of the fatty acids have conjugated double bonds. Many similar mistakes have been found throughout the book.

A further fault of the book is the inclusion of outdated and obsolete references. Thus, for instance, on page 45 the detailed composition of linseed oil is quoted as reported by Brosel in 1928. More reliable results of detailed analyses of linseed oil samples by a number of workers using modern analytical tools and techniques have become available in recent years. Selection from these could have been made with advantage. There is hardly a page in the book where corrections or improvements could not be suggested. The index is incomplete and unreliable. Here we find the extraordinary fact that the index to a book dealing with paint and paint materials does not contain a single entry for 'Linseed Oil'.

G. Winter.

Parasitology

Introduction to Parasitology. With Special Reference to the Parasites of Man. By Asa C. Chandler. (New York: John Wiley, 1949. 756 pp.) Price, $6.00.

It is a pleasure and inspiration to read what Asa Chandler has to say about parasitology. He writes with a refreshing and stimulating style, brings the past up to date and presents the new things with reservations and often shrewd comments. It is clear that he has taken a great deal of trouble with the eighth edition. The principle of emphasizing the biological, rather than the clinical, aspects of parasitic diseases has been maintained. Life cycles, epidemiological factors, relations between host and parasite and the underlying principles of treatment and prevention, are given greatest consideration.

Among the major changes are a new section on arthropod-borne bacteria, rickettsiae and filterable viruses and a section on insecticides and repellents. The Acanthocephala has a chapter to itself. There are new keys for the identification of some of the arthropods. The parasites of domestic animals have more space and there are many new illustrations.

The stimulus to various aspects of parasitology due to the second world war is noted along with the tremendous amount of research which was carried out in consequence of changed epidemiological relationships. The aggregation of large numbers of susceptible human hosts in regions where there were reservoirs of infection and suitable vectors provided full scope for the parasites concerned. In many cases there was a dangerous lack of research workers experienced in such diseases as malaria, amoebiasis, schistosomiasis, leishmaniasis, scrub typhus, etc. This lack and its military consequences focused attention on parasitology as a science—related chiefly to medical science it is true, but also as a science in its own right.

Parasitology as a separate subject in a science curriculum is deserving of much more attention than it commonly receives. Chandler's book is an admirable introduction to the science because it begins with a general account of parasitism written in an interesting and stimulating way and leads through the historical aspects of parasitology to a discussion of the special features of parasites in general.

The helminths and arthropods are dealt with in eighteen chapters; the protozoa in six,

including one which includes the rickettsiae; and there is a separate chapter for spirochaetes. The text deals in detail with the parasitic diseases of man, but there are brief summaries on most of the important parasites of domestic animals. References are grouped at the end of the chapters for which they are relevant and at the end of the book there are lists of the more important periodicals which contain parasitological papers.

The book is well set up and printed on fine paper. Every parasitologist will find Chandler's eighth edition not only an unfailing reference but also an unfailing stimulus.

H. McL. Gordon.

Pharmacology

The Chemistry of Organic Medicinal Products. Third edition. By G. L. Jenkins and W. H. Hartung. (New York: John Wiley; London: Chapman and Hall, 1949. 745 pp., 75 tables. 6″ × 9″.) Price, $7.50.

'Jenkins and Hartung' has now earned itself a place on the bookshelf of the medical scientist by virtue of two previous editions, and it is very pleasing indeed to see that the third edition is now to hand. Progress in pharmacology is rapid and new therapeutic agents appear almost daily; so that only by frequent editing can a book of this type retain its singular value.

The authors are to be congratulated upon the achievement of a very difficult object, that of classifying drugs according to a chemical system. Although this has resulted in pharmacologically related drugs becoming somewhat separated, it is an approach which is unusual and should render this book of greater value to the chemical worker than many of the standard texts in pharmacology.

The new section on antihistamine drugs is useful and well annotated. The antibiotics have been summarized in some ten pages, compared with a few paragraphs in the 1943 edition.

The authors give brief outlines of the pharmacological properties of many of the drugs discussed; it is here, perhaps, that the book is less reliable. Few pharmacologists would consider that in discussing the disadvantages of chloroform as an anaesthetic the possibility of liver damage should be totally ignored. It is customary, too, to assay insulin in terms of International Units; and it is regrettable that the amount of protanine in protanine zinc insulin preparations as described in this book is only a tenth of that usually employed. Again, on page 546, we must conclude that the authors intended to liken the analgesic effect of pethidine to that of morphine, since paverine is usually considered inert in this respect.

The book is a useful reference book and singularly wide in its scope; but it is a pity that such defects as have been indicated were allowed to remain.

R. H. Thorp.

Philosophy of Science

Philosophy of Nature. By Moritz Schlick. Translated by Amethe von Zeppelin. (New York: Philosophical Library, 1949. 136 pp. 5½″ × 8½″.) Price, $3.00.

Moritz Schlick occupied the Chair of the 'History and Philosophy of the Inductive Sciences' in the University of Vienna until he was shot by a mentally unhinged student in 1936. He had a wide influence at Vienna in the years between the wars, and gathered around him the 'Vienna circle' of mathematicians, logicians, philosophers, physicists, biologists, etc., with the object of evolving a new approach to philosophy which would be consonant with the modern sciences. They rejected what they regarded as the old, outworn, unscientific metaphysics of the Middle Ages, with its absurd *a priori* notions which had for so long hampered the progress of the experimental sciences. Schlick and his circle made a clean sweep of the past and started afresh. They introduced what they believed to be a new, undogmatic, rational and enlightened system of philosophy which would be a help to the progress of the sciences instead of a hindrance.

Thus was born the system of 'logical positivism'. It spread from the banks of the Danube to other countries; it found a notable exponent at Cambridge in the person of Ludwig Wittgenstein, one of the most influential philosophers in the English-speaking world in recent times; its principal home today is in the United States of America.

Schlick's chair at Vienna had been held with great distinction by Ernst Mach, and Schlick's philosophical views are very largely a development of the phenomenalism of his predecessor. Schlick's powers were not, however, of such a high order as those of the author of *Die Mechanik in ihrer Entwickelung*, which is a work of genius in its class; indeed in some respects the most considerable work on Mechanics since Newton's *Principia*. Schlick's aim was more modest: it was to evolve an *ancilla* to the sciences based on Mach's principles.

The 'Vienna circle' believed that the old speculative philosophy had rightly been cast out in favour of positive sciences which alone gave real knowledge. But, on the other hand, they believed the positive sciences were not sufficient in themselves; they needed external assistance for their full exposition and interpretation.. This expository and interpretative function is the task of the new Philosophy of Nature. Schlick writes:

> The typically scientific methods assist in the discovery of truth while the effort of philosophy is directed to the elucidation of meaning. The task of a philosophy of nature is thus to interpret the meaning of the propositions of natural science; and therefore the philosophy of nature is not itself a science, but an activity which is directed to the consideration of the meaning of the laws of nature.

This is not the place for any detailed critical examination of logical positivism; suffice it to say that the system has an air of plausibility which diminishes the more it is looked into. The Vienna philosophers, like so many before them, made an heroic attempt to start afresh in thinking about the world with no references to the accumulated experience of past ages. But, as Dr. Johnson once remarked, 'A system built upon the discoveries of a great many minds is always of more strength than what is produced by the mere workings of any one mind, which, of itself, can do little. . . . The French writers are superficial, because they are not scholars, and so proceed upon the mere power of their own minds; and we see how very little power they have.'

Substitute 'Viennese' for 'French' in these remarks, and we have a just observation about Schlick and his circle: they are conspicuously lacking in scholarship, so that their philosophy tends to be shallow and naïve. Earlier philosophers, like Aristotle and Kant, had penetrated deeply into the nature of the sciences. But, in what we can only regard as a spirit of pride, the Vienna circle completely ignored their contributions, to their own impoverishment.

The present work was left behind in manuscript form by Schlick at his death. It is now translated and published for the first time, supplemented by chapters on biological subjects taken from Schlick's lectures. The various chapters deal with a great variety of topics in the realm of philosophical physics, and are not without value even apart from the philosophical convictions which inspired them.

G. W. R. Ardley.

Zoology

The Story of Animal Life. Volume I: The Framework of Animal Life; Invertebrates. Volume II: Vertebrates. By Maurice Burton. (London: Elsevier, 1949. Volume I: 381 + xii pp. Volume II: 423 + viii pp. Over 1000 photographic illustrations, eight coloured plates. 7¼" × 10½".) English price, £3. 3s.

This is a large and very beautifully illustrated book whose author's aim is 'to examine the classification, structure and behaviour of animals against an evolutionary background in such a way that the reader may develop an appreciation of the long history of the animal world, its relationship with the rest of the living world and the underlying motives of animal behaviour'. The first volume begins with a series of chapters on such topics as 'the origin of life', 'the history of life', and so on, and then deals with the invertebrate phyla in systematic order. In this section there seems to have been a loss of balance, for of approximately 230 pages devoted to invertebrate groups, about 120 are given over to the arthropods, which receive ten out of the sixteen chapters in this part of the volume. All the worms are disposed of in 12 pages! The second volume, on the vertebrates, is much less open to such criticism. It is, however, in this volume that one might have hoped to find stronger expression of the evolutionary background mentioned in the preface; and it is disappointing that there should be no discussion at all of the origin of land vertebrates, of reptiles, or of birds and mammals. It is true that there is a brief mention of these events in the chapter on 'The Geological Record' in Volume I, but it does not seem that the aim, of presenting animal life against the background of its evolution, has been achieved.

The book is, in fact, in the direct line of descent from other similar wonderfully illustrated works; but it does differ from most of them in its discussions of special topics of interest such as migration in various groups, the senses of reptiles, and especially in the introductory chapters of the first volume.

The illustrations are very numerous and nearly all from photographs. Many, of course, are quite conventional animal photographs such as one has seen many times before; but a number are quite remarkable, as for example a series showing a hermit crab and two anemones moving from one shell to another, a group of young snakes in the act of hatching, a snake eating a mouse, a flying lemur in flight, and many more.

P. D. F. Murray.

(*Continued from page 204*)

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Supplement to THE AUSTRALIAN JOURNAL OF SCIENCE, Vol. 13, No. 1, August 1950.

The Australian Journal of SCIENCE

INDEX TO VOLUME 12 (1949-50)

AUSTRALASIAN MEDICAL PUBLISHING CO. LTD.
SEAMER AND ARUNDEL STS., GLEBE, SYDNEY

The Australian Journal of Science

Volume 13, Number 1

AUGUST 1950

THE AUSTRALIAN NATIONAL RESEARCH COUNCIL

Science House, 157 Gloucester Street, Sydney

Registered at the General Post Office, Sydney, for transmission by post as a periodical.

Edited
by
R. L. Aston

AUGUST 1950
Volume 13
Number 1

The Australian Journal of Science

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Published Six Times a Year

Annual Subscription: Ten Shillings

Price per issue: Two Shillings.

Business Manager: S. J. Copland.

The Australian National Research Council, Science House, 157 Gloucester Street, Sydney

Edited
by
R. L. Aston

OCTOBER 1950
Volume 13
Number 2

THE AUSTRALIAN JOURNAL OF SCIENCE

CONTENTS

Published Six Times a Year

Annual Subscription: Ten Shillings
Price per issue: Two Shillings

Business Manager: S. J. Copland

The Australian National Research Council, Science House, 157 Gloucester Street, Sydney

Edited
by
R. L. ASTON

DECEMBER 1950
Volume 13
Number 3

THE AUSTRALIAN JOURNAL OF SCIENCE

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Published Six Times a Year
Annual Subscription: Ten Shillings
Price per issue: Two Shillings
Business Manager: S. J. Copland
The Australian National Research Council, Science House, 157 Gloucester Street, Sydney

Edited
by
R. L. Aston

FEBRUARY 1951
Volume 13
Number 4

THE AUSTRALIAN JOURNAL OF SCIENCE

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Published Six Times a Year
Annual Subscription: Ten Shillings
Price per issue: Two Shillings
Business Manager: S. J. Copland
The Australian National Research Council, Science House, 157 Gloucester Street, Sydney

Edited
by
R. L. ASTON

APRIL 1951
Volume 13
Number 5

THE AUSTRALIAN JOURNAL OF SCIENCE

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AUSTRALASIAN MEDICAL PUBLISHING CO. LTD.
SEAMER AND ARUNDEL STS., GLEBE, SYDNEY

Edited
by
R. L. Aston

JUNE 1951
Volume 13
Number 6

THE AUSTRALIAN JOURNAL OF SCIENCE

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Published Six Times a Year

Annual Subscription: Fifteen Shillings

Price per issue: Three Shillings

The Australian National Research Council, Science House, 157 Gloucester Street, Sydney

AUSTRALASIAN MEDICAL PUBLISHING CO. LTD.
SEAMER AND ARUNDEL STS., GLEBE, SYDNEY

The Australian Journal of Science

Vol. 13 | 21 August 1950 | No. 1

The Humanities and Higher Technical Education*

COLIN RODERICK†

DURING the past two years a long-term educational project in Australia has been the subject of comment in interested circles throughout the English-speaking world. That project is the institution of the N.S.W. University of Technology. It is only a few months ago that a beginning was made with the construction of the first University building; in the mean time, as all interested parties are aware, some of the University staff have been appointed, and they have been conducting classes in various branches of engineering and in some other technical subjects. Instruction, or training, has not been entirely confined to those technological fields; the field of the humanities has come in for its share of attention, perhaps not as properly as the critic would like to see, but at any rate in an exploratory sort of way. It is this field of the humanities that will be reviewed in this article, to see what reasons can be found for touching it, to discover what it has to offer the technical man, and to determine, if possible, what the Australian technological undergraduate ought to expect of the experience he *is* offered in the humanities.

He is entitled to ask—if he comes from a technical secondary school, as he quite often does—and he may very properly ask, 'What is this field of humanities?' Unless he and the public who are concerned with the use of public money are both aware of what the humanities are and what purpose they serve, they are in grave danger of misunderstanding the whole purpose of their inclusion in a technological curriculum. For too many years now the graduates of special schools in the established universities—such schools as those of engineering in all its branches, veterinary science, economics, agriculture, and medicine—have been too rigidly specialized. They have emerged with a degree indicating a sound knowledge of one narrow line of human experience, but without that preliminary introduction to other fields of activity that enables them to pursue their education after they have left the university. Under the pressure of their daily work, and confined in a social round that is inevitably linked with their profession, they find their lives gradually shrinking within a converging perspective that ends in total exclusion of everything but their own specialty. In the words of the cynic, they come to know more and more about less and less until they finish by knowing everything about nothing. It is to avoid the *tendency* to exclusive specialization that the humanities are included in enlightened technological institutes today.

Taken broadly, the humanities include literature, history, philosophy, and social anthropology—everything in fact that deals with the story of man and his home. Within these four divisions there is room for subdivision, even for addition. Any human activity that may liberalize thought is entitled to a place: thus we might include psychology, the fine arts, music, philology, foreign languages, architecture. There are some who would even include economics—although its devotees claim it as a science, some of the fanatical insisting that it is an exact science: but whether it is to be considered paramount or secondary in the humanities depends on whether you are a humanist or a realist. If you are a humanist, you will put literature, philosophy, music, art and languages first, psychology in all its branches next, and economics last. If you are a realist, and insist that even the humanities must be forced to fit a realist mould, you will probably put them in reverse.

The amplest justification for including the humanities in higher technological education is probably to be got from an examination of results in two or three of the great institutes that have been practising this sort of thing

* The substance of a talk given from broadcast station 2FC on 25 July 1950.

† Colin Roderick, M.A., M.Ed., Education Editor, Angus and Robertson Ltd., Sydney.

for many years. What is being done in Zürich and Massachusetts will be mentioned later; but the aims of undergraduate experience in the humanities, and the means by which those aims are to be reached, will be outlined at this point.

In the first place, these technical graduates are the men who will be asked in a few years' time to take executive and administrative posts in commerce, industry, and government. They may be called—it is almost certain they will be called—to take a post on boards of direction. They must be prepared for that. They ought to have a good grasp of affairs, they must be able to realize that there are other people in the world beside engineers, and that all of these people have, and are entitled to hold, opinions derived from different approaches to the same subject. They must be able to relate their engineering to life. By that I mean nothing abstruse or highfalutin, but simply that they must be able to argue consistently, logically, and clearly; speak and write persuasively and well; make out a case convincingly; and, most important, see their service in the light of its place in, and its value to, society. To enable the graduate to do this, the undergraduate must be introduced to the reality of relationships between the various fields of scientific, technical, industrial, and commercial activity. He must of his own volition and with perfect goodwill arrive at an appreciation of the value of other specialization: the practical way of helping him to do that is to offer him an apt curriculum, to introduce him, in short, to the history of Western civilization and of accepted Western philosophy. His linguistic studies ought to allow for all modern means of reaching an audience (including the medium of radio and the microphone); but they must first train him in the written forms he will be called upon to use in his executive capacity. Apart from practical exercises in English expression, he will catch points of style from the study of English models. Some of the best popular expositors of science and technology the world has known have written in English—you know them: Sir James Jeans, Eddington, Hugh Miller, W. J. Dakin—and a study of their work will save the technical student from the folly jargon.

What we might call the 'uneducatedness' of university graduates has long been a source of concern to the serious-minded University teacher. Of that we have been assured by more than one. That 'uneducatedness' is a condition the humanities ought to aim at minimizing. By a proper assortment of introductory courses, the graduate should have been put on the road to being an educated man. The second grand aim of the humanities faculty ought to be to keep open the windows of his mind. To make that point clear, let me quote from Walter Murdoch's essay 'On Education' in his *Collected Essays*. Murdoch says:

> The house of the mind possesses a number of windows, through which we look out on the great and moving spectacle of life. The educated man is the man able to use all these windows; if one of them is sealed, to that extent his education must be called defective; if all of them are sealed except one, he must be called—uneducated.

That sums up our argument in a nut-shell. Our men may well be specialists; it is a good thing that they be specialists; but they must not be what Murdoch calls 'one-eyed specialists'. In this, count me as Murdoch's disciple, for I believe, too, that 'if the history of great achievements be studied, it will be found that, while valuable things have been accomplished by the one-eyed variety, the most valuable of all have been done by specialists who were also educated men'. Therefore it is plain that our technical undergraduates are entitled to some experience in liberal studies. It is a simple matter of paying our debts. The technician gave us the radio set; we are doing no more than our duty in teaching him to appreciate its best uses. There is no need to give him five-finger exercises on the piano, but we should teach him something of the form and the history of music. If at the end of his course the Bachelor of Engineering prefers the popular contemporary ditty about a bunch of coconuts to the 'Song of the Flea', or boogie-woogie to Beethoven, the humanities have been found wanting. Also, if it comes about that he had to be forced into following the humanities, their organization will have been proved equally wanting. The essence of humanism is its liberal outlook. The Latin word *liber* has two meanings: one, an adjective, means 'free'—it has given us the word 'liberty'; the other, a noun, means 'a book'—it has given us

the word 'library'. If we ever have to enrol moral suasion in the organization of the humanities, you may wager that it is because someone has confounded his etymologies.

The reconciliation of liberal thought with technological efficiency—that is the goal. We may reach it best through literature, art, and music. Furthermore, because we are Australians, we should start with Australian literature. Assuming the undergraduate's course to last four years, he might take a weekly lecture in Australian Literature during the second year, and one in World Literature during the third and fourth years. This would not be compulsory, for compulsion would defeat the whole purpose of the faculty. The student's main task is to acquire professional skill; the humanities are to give him a wide outlook and to teach him to teach himself. Humanism considers the man first and the course of study second; therefore, although compulsory work may be judicious in the first year, it ought to diminish as the student advances through the University, and elective work take its place.

The Massachusetts Institute of Technology has been in existence for almost a hundred years, so that its organization of the humanities has to bear the burden of those traditions which weigh upon so many old foundations. Nevertheless its four years are divided thus:

- First Year: English Composition.
- Second Year: The United States in World History.
- Third Year: Economic Principles and one of these—Industrial Economics, *or* Labour Relations, *or* Introductory Psychology.
- Fourth Year: One of these—Fine Arts and Music, *or* International Relations, *or* History of Thought, *or* Western World Literature.

The emphasis is thus on Literature and the Arts.

In Zürich the courses are arranged otherwise. The student does one or two lectures a week in eight different topics covering a wide range, a range so wide that it would take several pages to enumerate them. Here are some: Russian for Beginners, Goethe's *Faust*, Philosophy of the Eighteenth Century, Pestalozzi's System of Education, Milton and the Puritan Age, Bismarck's Politics, Introduction to the Life and Works of Johann Sebastian Bach, History of Pictorial Art, the Art of the Middle Ages; and so on.

Of the two, the Zürich organization is the more liberal; but both are extremely valuable as guides to the sort of thing we aim at. We must not overlook Economics or the History of Science and Technology—a year's work in each is ideal for the first year; neither must we neglect History and Psychology—they could provide the kernel of the second year; Australian Institutions might well engross third-year men; and Music alleviate and illuminate the fourth. If a man wants to go beyond that, well and good—the facilities ought to be there to enable him to do so. If they are not, you may be sure our service to the humanities in higher technical education will have been of the variety known to the vulgar as lip-service.

The N.S.W. University of Technology

THE New South Wales University of Technology was established by Act of Parliament in April 1949. It had already commenced its operations by the institution of degree courses in four branches of engineering in March 1948.* This achievement had been effected by a Developmental Council, comprising representatives of the Government, the University of Sydney, the technical colleges of N.S.W., and industrial organizations, which had been appointed by the N.S.W. Government upon representations from its Minister for Education and which had met for the first time in August 1947.

The *Technical Education and University of Technology Act, 1949*, provides for:

(a) The incorporation of the University of Technology.

(b) The establishment of a Department of Technical Education.

(c) The constitution of a Technical Education Advisory Council to advise the Minister on the provision and conduct of technical education in accordance with the needs of the community and commerce, and on the co-ordination of the functions of the Department of Technical Education with associated educational bodies.

(d) The establishment of Technical Education Districts; the constitution, in respect of any such District, of a Technical Education District Council;

* This JOURNAL, *10*, 15 (1947); 111, 179 (1948). The project was then known by the name of the *N.S.W. Institute of Technology*. Later it was spoken of for a time as the *Technical University*; finally, as the *N.S.W. University of Technology*.

and the powers, authorities, duties and functions to be exercised and discharged by any such Council.

The Act defines the objects of the new University to be:

(*a*) *The provision of facilities for higher specialized instruction and advanced training in the various branches of technology and science in their application to industry and commerce.*

(*b*) *The aiding of research and other suitable means of advancement, development and practical application of science to industry and commerce.*

The governing Council, under the authority given to it by the Act:

(a) may provide courses in applied science, engineering, technology, commerce, industrial organization and such other related courses as it deems fit; and may, after examination, confer the several degrees of Bachelor, Master and Doctor, and such other degrees and such certificates in the nature of degrees or otherwise as it thinks fit;

(b) may from time to time appoint deans, professors, lecturers, and other officers and employees of the University;

(c) shall have the entire control and management of the affairs, concerns and property of the University;

(d) may act in all matters concerning the University in such manner as appears to it best calculated to promote the objects and interests of the University.

The Council has also been given power to establish and maintain branches, departments, or colleges of the University of Technology at Newcastle, Wollongong, Broken Hill, or such other places in the State of New South Wales as the Council deems fit.* Provision is made for the acceptance by the Council of gifts and bequests made to the University. Any land acquired for University purposes is to be vested in the Council. Special investigations may be carried out in any technological or scientific matter at the request of any authority, institution, association, firm or person; and in respect of such investigations the Council may charge such fees therefor and agree to such conditions in relation thereto as it thinks fit.

The constitution of the Council is prescribed by the *Act* to be of not more than thirty members,† as follows:

(a) five, nominated by the Minister, who in the opinion of the Minister are persons who by their knowledge and experience can advance the full development of the University;

(b) one from the Legislative Council;

(c) one from the Legislative Assembly;

(d) four from the professions;[1]

(e) two from Public Servants engaged in the administration of technical education;

(f) five representing industrial and commercial interests;[2]

(g) three representing trades unions and employee organizations;[3]

(h) one representing the University of Sydney;

(i) one elected by the undergraduates;

(j) one elected by the graduates;

(k) one elected by the teaching staff;

(l) the Director of the University;

(m) four representing the principal faculties.

Authority has been given for the erection of the first buildings of the University on a site in the Sydney suburb of Kensington, although the final site of the University has not yet been determined. Sketch plans were prepared in consultation with Professor F. E. Towndrow of the University of Technology, and commitments have been entered for constructional work to proceed. Expenditure on the first building when completed will be in the neighbourhood of £400,000. In the meantime, the University is availing itself of the existing resources of the technical education system of the State. Use is being made of the buildings, equipment and teaching staff of the Sydney Technical College. The University sets the standards, the form of courses, the syllabuses and matters of policy; the staff of the Technical College, especially before the appointment of the University professors, was asked to put them into effect. Courses commenced within the premises of the Sydney Technical College have been:

1948
- Civil Engineering,
- Mining Engineering,
- Mechanical Engineering,
- Electrical Engineering.

1949
- Applied Chemistry,
- Chemical Engineering.

1950
- Architecture,
- Electronic Engineering (post-graduate).

* It was partly the recognition of the claims of such centres that led to the adoption of the title, the *New South Wales University of Technology*.

† See below, page 15.

[1] Selected from: The Institution of Engineers, Australia, Sydney Division; The Institution of Engineers, Australia, Newcastle Division; The Royal Australian Chemical Institute, N.S.W. Branch; The Institute of Optometrists of New South Wales; The Royal Australian Institute of Architects, N.S.W. Chapter; The Institution of Production Engineers, Sydney Section; The Institute of Physics, Australian Branch, N.S.W. Division.

[2] Selected from: The Chamber of Manufactures of N.S.W.; The Sydney Chamber of Commerce; The Metal Trades Employers' Federation; The Employers' Federation of N.S.W.; The Building Industry Congress of N.S.W.; The Institute of Management; and, conjointly, the Primary Producers' Union, the Graziers' Association of N.S.W., the Farmers' and Settlers' Association of N.S.W., and the Wheat Growers' Union of N.S.W.

[3] Selected from one nomination submitted by the Labor Council of N.S.W. and three nominations submitted by the Technical Teachers' Association of N.S.W.

Instruction in the first years of the courses in Civil, Mining, Mechanical, and Electrical Engineering also commenced in 1950 in the Technical College at Tighe's Hill, Newcastle, N.S.W.

Consideration is being given to the establishment of courses in such subjects as Metallurgy, Food Technology, Management and Administration, Engineering Surveying, Textile Technology, Building Science, Applied Physics, and Optometry.

The Council of the University met for the first time on 6 July 1949. Six professors and a number of lecturers have been appointed. There was a total enrolment of 150 students in 1949.

Curriculum

The standard requirement for admission as a student is a 'pass' in English, Mathematics, and three other subjects in the Leaving Certificate Examination conducted by the N.S.W. Education Department, or an equivalent examination; but alternative qualifications may be considered. The courses for the degree of Bachelor, which may be in Applied Science (B.Sc.), Engineering (B.E.), or Architecture (B.Arch.), are of four years duration. Post-graduate courses will lead to the degrees of Master and Doctor in Science and in Engineering. The *Calendar* of the University states (p. 42) that the courses of the University aim to provide:

(a) a thorough training in the fundamental sciences of mathematics, physics and chemistry;

(b) a sound training in the professional aspects of the course chosen and such subjects in allied professional fields as are considered necessary;

(c) a close link with industry and the practical aspects of the profession throughout the course;

(d) a study of the art of expression, both written and oral, and of selected general subjects which aim to extend the student's understanding of himself and his environment.

Industrial Experience

A proportion of the student's time must be spent in obtaining industrial experience, as an integral part of each course. In the Engineering courses, the first three years each comprise 24 weeks at the University, in two terms, from March to September; followed by 23 weeks gaining approved practical experience. In the fourth year, the 32 weeks are spent at the University. In the Applied Chemistry and Chemical Engineering courses, the first year is spent at the University over 32 weeks in three terms, and the fourth year over 36 weeks in two terms; but in the second and third years the student attends the University for two evenings and two half-days a week over 37 weeks in three terms, leaving other days free for works practice as an employee in industry. Programmes of progressive industrial experience are determined in collaboration with the industrial establishments concerned.

Humanities

On the other hand, it is a feature of the University that all courses deliberately devote from six to ten per cent. of curriculum time to the Humanities. Thus, as well as the seven Degree Courses so far established, the University has four auxiliary courses:

Physics, two years for all courses;
General Science (i.e., Geology), three years for mining engineers, one year for civil engineers;
Mathematics, two years for all courses, three years for electrical and civil engineers;
Humanities, four years for all courses.

As the innovation of compulsory 'Humanities' is of special interest, the curriculum will be described in some detail.

The courses in Humanities are grouped as follows:

(1) Scientific Method, in the first year; History of Science and Technology, in the second year; Contemporary Civilization, in the third and fourth years.
(2) Language and Literature, in all years.
(3) Human Relations, in the second, third and fourth years.

'The aim of the course in *Scientific Method* is to provide students with a grounding in logic and scientific methodological procedure and at the same time to inculcate an appreciation of the universal nature of science.' The aim of the course in *History of Science and Technology* is 'to enable the student (*a*) to see the sphere of science or technology which he is entering in relation to the general perspective of scientific and technological development; (*b*) to gain an understanding of the relation between scientific and technological development and the conditions of society'. In the first course on *Contemporary Civilization*, 'an historical approach is made to Economic Theory treated in conjunction with selected aspects of Economic History'. 'The general aim of the course is to develop an appreciation of the practical basis of economic theory and to show how it has developed under the influence of historical situations, particularly of ideas: in this way, the close inter-connexion of economic theory with life is indicated.' The subject is treated critically as well as descriptively, to enable the student 'to assess economic affairs for himself without being swayed by propaganda, indoctrination or prejudice'. In the final year, the course is one in Contemporary International Relations, operated on the seminar method. Its aims include the interpretation of news, and a knowledge of where to look for specialized information; as well as an understanding of other peoples which may help the graduate in his professional contacts.

The courses in *Language and Literature* include:

(a) Theory of Language, Standard English, Semantics—over three years.

(b) Literature in Relation to Social Criticism, to the Study of Personality, to the Study of Social Forces, and to Analysis and Criticism—each over one year.

(c) Technical Exposition—over the four years.

'The series of courses on *Human Relations* aim at an understanding of the dynamic inter-relationship between human beings, and the value of such an understanding for successful social living in general and for harmonious industrial relations in particular.' The first year of the course deals mainly with the psychology of the individual, and the second with social reactions. In the final year the industrial situation is 'taken as a segment of the total social pattern'. The seminar method is used throughout.

Publications

Details of courses were first published in January 1949 in a 100-page duplicated type-script *Bulletin of Information*. The first *Calendar of the New South Wales University of Technology* was issued for 1950. A 24-page printed descriptive pamphlet, entitled *The New South Wales University of Technology* was published in November 1949.

Post-Graduate Courses

The conduct of post-graduate courses is intended to be an important activity of the University, designed to meet the needs of industry which arise from time to time because of recent scientific and technical developments. There will also be courses extending the fundamental undergraduate curriculum into more specialized and detailed study of specific professional fields. The courses will be at three levels:

(a) lectures, generally in the evening, to the public or to technical industrialists, on subjects of general interest;

(b) lectures and laboratory work, usually in the evening, followed by an examination leading to a certificate;

(c) study or research leading to degrees such as Master of Engineering or Master of Science.

A two-year course for the degree of Master of Engineering in the field of Electronic Engineering has been organized to be available from 1950. Post-graduate activities will be expanded as staff and facilities become available. The shorter post-graduate courses will be announced from time to time as the need for them becomes apparent.

Student Life

Academic dress is to conform as far as is practicable with that of the University of Sydney, subject to innovations respecting graduates in any new fields of technology which may be recognized. Provision has been made for conversion courses to allow holders of Technical College diplomas, and Technical College students who are part way through diploma courses, to enter the degree courses of the University at appropriate stages. Student activities are organized by the *Society of Students of the New South Wales University of Technology*, the aims of which are:

(a) to ensure and facilitate co-operation between students and administrative officers of the University;

(b) to promote cultural and social advancement of University students;

(c) to arrange sporting and recreational activities for the students;

(d) to discuss all problems confronting the Society;

(e) to promote the aims of the University of Technology.

Student teams have been organized in football, basketball and other sports. Lunch-hour discussion groups are conducted.

The University has shown an interest in the arrangement of financial assistance for its students during their university years. Exhibitions and bursaries are granted by the Government of New South Wales. Twelve scholarships in Mining Engineering are offered each year by the Joint Coal Board and three by the N.S.W. Combined Colliery Proprietors' Association. Government departments, and a number of industrial establishments, sponsor the attendance of employees and cadets; in many cases accepting years of attendance at the University as part of service for seniority grading.

RESEARCH

The University is at present making use of the staff of the Sydney Technical College for many of its research projects. It is the policy of the University to appoint research officers and technical officers, with no teaching commitments, to assist the lecturing staff. A Co-ordinator of Technical Planning and Research is to ensure the best utilization of the relevant resources of all departments in relation to the projects undertaken.

Two members of the Department of Chemistry are collaborating with the C.S.I.R.O. Division of Plant Industry in an investigation of plant products, especially the saponins and pectins. New synthetic work on organic compounds is in progress, particularly those related to penicillin. A high-pressure hydrogenation plant, complete with instruments of control and analysis and valued at £100,000, has been purchased from the Australian Government. The plant was a German reparations item, used

in Germany to investigate coal hydrogenation catalysts; it can also be used for almost any liquid-phase or vapour-phase continuous reaction, employing pressures as high as 700 atmospheres. It includes small-scale and large-scale pilot-work facilities. A laboratory for semi-micro-analysis has been installed in the Department. The physical chemistry laboratory is equipped with an electron microscope and with a polarographic and infra-red spectroscope. Research is proceeding in the Department upon the automatic control of plant used in industry.

A sum of £75,000 is being spent on the conversion of an existing structure to house laboratories for research in connexion with Civil Engineering. Full air-conditioning will be installed for positive control of atmospheric conditions; provision will be made for the testing of soils, concrete, steel, timber and other materials. A soil mechanics laboratory will be established, and a photogrammetric laboratory. The Civil Engineering Department is giving attention to the design and building of electric calculating machines especially suited for the analysis of continuous frames, or of electrical networks, or of vibration problems.

A radiation laboratory is being planned for the Department of Electrical Engineering for industrial X-ray work. A 250,000-volt unit is being purchased; together with a 16-million-volt betatron. The betatron will be used to X-ray large castings, and will also provide an initial instrument for nuclear research by the Department of Physics. Work has been started on the properties of electrical insulating materials made in Australia.

The Department of Mining Engineering has been working in collaboration with the Joint Coal Board in the rehabilitation of the coal industry. Construction of laboratories has been started. Research is planned upon spontaneous combustion; the properties of coal and coal-measure rocks; strata control; shot-firing and the efficiency of blasting; the dust problem in mines; ventilation of mines; and the preparation of minerals for marketing.

The Department of Physics is engaged on two major research activities. In the first, a Hilga research X-ray unit is being used to study metallurgical and dielectric materials by crystallographic diffraction; the results being co-ordinated with metallurgical research using the Hilga spectrograph and spectrophotometer. The second programme is the field of vacuum physics and the development of special electronic valves. Work planned in connexion with the betatron encompasses the instrumentation side of radiation measurements, together with health protection for industrial X-ray work of high intensity.

A further article on higher technological education is to follow this article.

The Significance of Endosperm

N. H. White*

In seed development of flowering plants there are two important nutritive phases. One is concerned with differentiation and development of the embryo from the zygote or fertilized egg, and does not involve the deposition of food reserves. The other is concerned with the provision of food reserves to be utilized by the embryo seedling during seed germination. Endosperm function in seeds is universally recognized as being nutritive, but it is not generally appreciated that its al. important nutritive function is concerned with embryo development rather than with seed germination.

After consulting modern text-books of botany, and those trained in biology, the writer concludes that the prevalent concept of endosperm is that it is starchy or oily food reserve in seeds, or is more concerned with the second nutritive phase in seed development. That this should be so is surprising, because a survey of recent literature on seed development makes it abundantly clear that endosperm has the predominantly important role in the first nutritive phase of seed development.

Endosperm has in fact made embryo development possible in flowering plants. It provides the medium *par excellence* for the development of the embryo. With the exception of the *Orchidaceae* (orchid family) and some species of a few other families, endosperm is always present during the early stages of embryo development. In seed failure the endosperm fails to develop, with the result that embryo development is arrested. It is significant that in the orchids, and the few other species that never develop functional endosperm, the embryos are small masses of undifferentiated tissue which will only develop into mature embryos when supplied with nutrients from their environment. Under natural conditions, fungal hyphae generally invade the tissues of these primitive embryos, which derive their nutrients from the fungal hyphae. This is the well known mycorrhizal association of orchids, which continues throughout the life of those plants. These undifferentiated embryos may be induced to develop into mature embryos, and later into seedlings, by placing them in artificial nutrient media containing suitable sugars and vitamins or growth-promoting substances. These media must remain free from contamination. Likewise the undifferentiated embryos, less than 0·5 mm. in diameter, may be removed aseptically from developing seeds of species in which endosperm normally functions; and when these are placed in suitable nutrient media they develop into mature embryos (La Rue, 1936). Hainig (1904) was

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one of the earliest to demonstrate the development of plant embryos *in vitro.* Embryo culture, by supplying the undifferentiated embryos with what is virtually an artificial endosperm, is being utilized by geneticists and plant breeders today to overcome sterility in interspecific hybrids (Skirm, 1942). Sterility in these hybrids was found to be due largely to the failure of endosperm and nutritive tissue surrounding the endosperm.

With the knowledge of the primary function of endosperm in conveying the embryo through its development from the zygote, the phenomenon of double fertilization, peculiar to the flowering plants, becomes more intelligible (Brink and Cooper, 1940). This double fertilization consists of the fusing of one of the two genetically identical microgametes, derived from a single generative nucleus of the pollen grain, with the diploid polar nucleus in the embryo sac, to form a triploid primary endosperm nucleus. The other microgamete fuses with the haploid egg nucleus to form a diploid

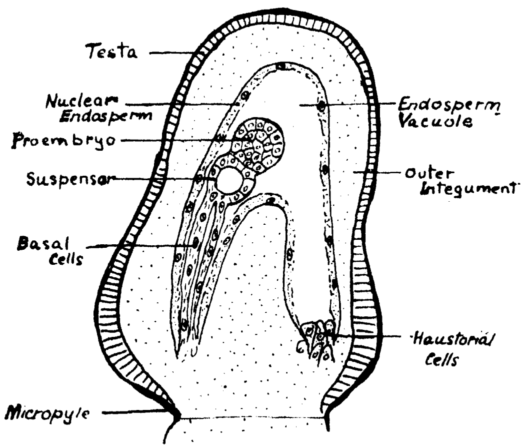

FIGURE 1. L.S. developing pea seed.

zygote nucleus. The triploid endosperm nucleus has the advantage of an extra set of chromosomes over that of the diploid zygote. This enhanced heterosis or hybrid vigour enables the endosperm 'to get away to a good start' and develop in advance of the zygote. That it is essential for the endosperm to develop ahead of the zygote is revealed in seed failure and in some interspecific hybrids where the endosperm fails to do so.

In the early stages of endosperm formation, the primary endosperm nucleus divides mitotically to form numerous nuclei. The nuclei may remain as free nuclei in the cytoplasm of the enlarging embryo sac; the endosperm so formed is referred to as nuclear endosperm. In some species the nuclei may be surrounded by cytoplasm and separated by cell walls, the space of the embryo sac becoming filled with these endosperm cells, giving what is known as cellular endosperm. In the early stages of seed formation, however, the embryo sac rarely becomes filled with endosperm cells. It is usual for the nuclear type of endosperm to develop at first and then to give place to the cellular type. In some species, as in most of the legumes, the endosperm remains nuclear throughout the development of the embryo. The whole vacuole is lined with the thin layer of multinucleated endosperm, seen clearly in the developing seed of the garden pea (Figure 1). In other species the nuclear type of endosperm gives place to the cellular type, as in the drupaceous plants like the peach or plum. The form of endosperm varies between species, but in all it is the key tissue for embryo development.

In some species, notably the members of the families *Chenopodiaceae* (beet), *Rosaceae* (pome and stone fruits), *Polygonaceae* (rhubarb and docks), and *Caryophyllaceae* (chickweeds and carnations), the nucellus, or tissue surrounding the endosperm, assists in the nutrition of the developing embryo, but is ancillary to, and acts through, the endosperm. In all these the nucellar tissue greatly increases in amount during seed development. Nevertheless, the development of the zygote into an embryo does not take place until the endosperm develops. When endosperm is formed, it increases at the expense of the nucellus; in some cases it may completely replace the nucellus tissue, as it does in pome and stone fruits; or it may only partially replace the nucellus, as it does in *Chenopodiaceae* and *Polygonaceae.* When some of the nucellus remains in the mature seed it is then termed perisperm. The sequence of nucellus replacement by the endosperm, and absorption of the endosperm by the embryo, is well demonstrated in a partially developed seed of a plum or other drupaceous species (Figure 2). In this

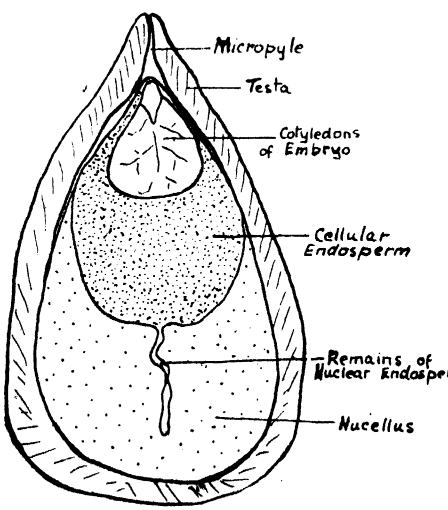

FIGURE 2. L.S. developing seed of plum

the seed will be seen to consist of part unabsorbed nucellus and part endosperm; and, at the micropylar end, the differentiating embryo.

Cytochemical reactions indicate that the endosperm and nucellus do not contain reserve foods such as starch and oil, but rather they contain readily assimilable substances. Food reserves only appear in these structures should they persist in the mature seed.

Having fulfilled its important primary function of conveying the embryo through its early stages of differentiation, the endosperm is entirely or partially replaced by the cotyledons of the embryo. The second nutritive phase, of laying down food reserves, begins after the differentiation of the embryo; and starch and oils begin to appear in tissues that will persist in the mature seed. The cotyledons of the embryo are the principal food storage tissue in seeds, and are most readily accessible to the embryo seedling. These organs also function as absorbing organs when endosperm is being absorbed during development. If endosperm absorption is incomplete at maturity, as in seeds of onion, castor oil, and tomato, the cotyledons still function as absorbing organs during seed germination, when all reserves in the remaining endosperm are first exhausted before the emergence of the cotyledons.

In the *Gramineae* (family of grasses and cereals), the endosperm during embryo differentiation is nuclear and is entirely free from starch; but the nuclear endosperm is replaced with cellular endosperm, which develops enormously compared with the size of the embryo. As this cellular endosperm is laid down, so starch is formed in the cells of the tissue; but this takes place only after embryo differentiation is completed.

It is indeed unfortunate that the terms 'starchy' and 'endosperm' have become so closely linked, for the seeds of relatively few species store their food reserves as starch. More often they are stored as oils and proteins.

So far as endosperm is concerned, the function of food storage for seed germination is a secondary one; with the exception of the members of the Gramineae, it must be regarded more or less as an accidental sequence to the all-important primary function of conveying the young embryo from the zygote to the mature stage.

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Polarography Conference

A ONE-DAY conference on Polarography was held in the Chemistry Department, University of Sydney, on Friday, 2 June 1950. There were approximately one hundred people present, from industry, the C.S.I.R.O., and academic institutions, when the Chairman, Dr. B. Breyer, opened the conference. Dr. Breyer welcomed the participants and outlined briefly the present importance of polarography in fundamental and applied research. Eight papers, each followed by discussion, were read at the three sessions of the conference. It is hoped that a further conference will be held in 1951.

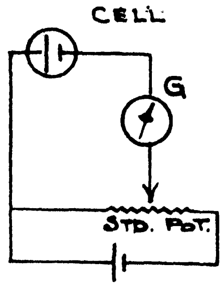


FIG. I

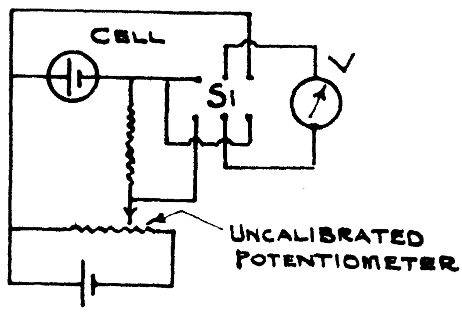


FIG II

FIGURES 1 and 2.

POLAROGRAPHIC INSTRUMENTATION

The first paper was read by H. A. McKenzie, of the C.S.I.R.O. Food Preservation Research Laboratory. The simplest circuit, the direct galvanometric deflection method of Heyrovsky, is the most generally useful. The use of R.C. filters for this circuit is of doubtful value. The null method, in which the current is measured by the potential drop across a series resistance, is not quite as satisfactory as the balanced current method (similar to that often used for photo-cells). Large external series resistance can have quite a serious effect on the

shape of the polarographic wave, for which the simple I.R. correction is inadequate. The three methods were compared as regards accuracy in measurement of diffusion current, half-wave potential, and slope of waves. Experiments to determine the rate of growth of current during the life of a drop, using a Brush Development Co. pen recorder, show that the current does not grow as the one-sixth power of the time, as proposed by Ilkovic. The significance of these observations in measurement of the average diffusion current was discussed.

By courtesy of the Directors of Davis Gelatine (Australia) Pty. Ltd., A. Millership described a '*p*H-meter' polarograph developed by him and his associates. The simple Heyrovsky circuit, shown in Figure 1, can obviously be replaced by that of Figure 2,

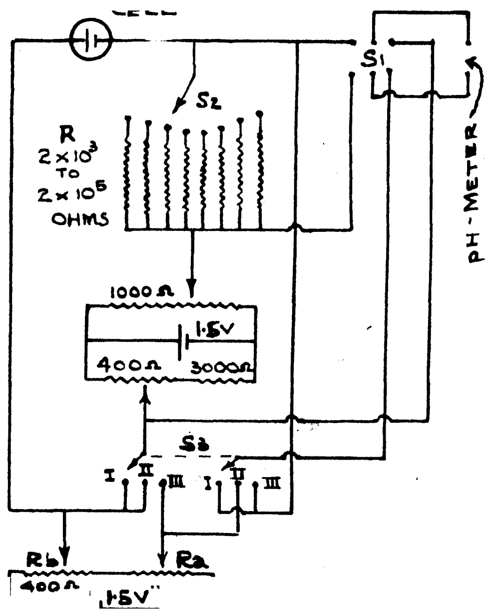


FIGURE 3.

where both elements of the polarographic plot are expressed as a potential difference, measured alternately by way of the two-way switch S_1 on a high-resistance millivoltmeter, V. An ordinary *p*H-meter, designed for use with the glass electrode, is in effect a vacuum-tube millivoltmeter and, especially if provided with a millivolt scale, is particularly suitable as the measuring element V. The galvanometer built into the *p*H-meter is used as a null instrument, the onus of measurement being placed on the slide wire. The complete circuit is shown in Figure 3. Sensitivity is varied by S_2, which selects the appropriate current-measuring resistor R. Range extension is effected by switch S_3. In position I, the network R_{ab} is by-passed; in position II it is connected to the input of the *p*H-meter and may be pre-set to any convenient E.M.F.; in position III this pre-set E.M.F. is added to that indicated by the *p*H-meter and the range is extended accordingly. The system outlined above was developed in 1947 and has been used continuously since that time. Lingane (1949)* has described and recommended a circuit similar to that of Figure 3. He neither makes use, however, of a potential meter of high input resistance nor includes variable sensitivity or range extension—features which contribute to the practical value of the present circuit.

S. Hacobian discussed work which he is carrying out on alternating-current polarography at the Department of Agriculture, University of Sydney, under a Science and Industry Endowment Fund grant. He summarized the main advantages of A.C. polarography as follows. A.C. polarography can be carried out in solutions containing dissolved air; tedious curve-recording is replaced by a single current reading at the summit potential, which yields directly both the half-wave potential and the concentration of electroreducible substance; small amounts of less noble ions can be estimated even in the presence of a large excess of nobler ions; polarographic waves only 40 mV apart are clearly separable; an improved reproducibility is obtained; there is a simplified system of recalibration in cases of capillary replacement; the use of delicate galvanometers is eliminated.

REDUCTION OF COUMARINS

The second session opened with A. J. Harle of the Sydney Teachers' College, on 'Reduction of Coumarins'. The polarographic behaviour of coumarin was simple in that, for any *p*H where reduction occurred, there was only a single wave, the half-wave potential of which was $-1 \cdot 54$ volts *vs* S.C.E. and was independent of *p*H and temperature. The wave height varied with *p*H, and was a maximum at about *p*H 6, falling away to zero at about *p*H 11. The ultra-violet absorption spectra showed a gradual change over the *p*H range from 7·5 to 12·2. Both polarographic and spectroscopic results are explicable by the assumption of a *p*H variable interchange between the lactone and coumarinic acid forms of coumarin. It is concluded that the lactone, which is the stable form in acid media, is reducible over the studied potential range, but the acid is not reducible over that range. Further, the lactone is not present above *p*H 11·2, the acid not being present below *p*H 6·8 (at 10^{-3}M concentration). The number of electrons concerned in the reduction was calculated to be one. The reduction product consisted of two isomers of the formula $C_{18}H_{14}O_4$, corresponding to the *dl* (racemic) and *meso* forms. The suggested polarographic reduction is:

* LINGANE, J. J. (1949): *Anal. Chem.*, 21, 45.

$$R + e \rightarrow R^{\overline{\cdot}} \quad \ldots\ldots\ldots\ldots \quad (1)$$
$$R^{\overline{\cdot}}(+ H^{+}) \rightarrow RH\cdot \quad \ldots\ldots\ldots \quad (2)$$
$$2RH\cdot \rightarrow R_2H_2 \quad \ldots\ldots\ldots\ldots \quad (3)$$

where R is the lactone coumarin. Step (1) is proved by the $E_{\frac{1}{2}} \triangleq pH$ invariance; step (3) is supported by the formula of the product; and step (2) is the necessary intermediate. Four naturally-occurring coumarin derivatives were examined at *p*H's favouring the lactone form, the results indicating that the coumarin nucleus is reduced in each case, other substituents in the benzene ring merely causing a small change in the half-wave potential.

Polarography of Benzophenone

H. J. Gardner, of the Chemistry Department, University of Sydney, then described his researches on 'The Polarography of Benzophenone'. In a suitable supporting electrolyte at *p*H 2, benzophenone gives two one-electron steps. Dependence of the first wave upon the hydrogen ion concentration indicates that the electrode reaction is

$$(C_6H_5)_2C = O + H^{+} + e \rightarrow (C_6H_5)_2\dot{C} - OH$$

The free radical readily polymerizes to form benzopinacol, which is the product isolated by suitable electrochemical reduction. Further increase of the potential causes the free radical to take up another electron and presumably a hydrogen ion, although there is no dependence of the half-wave potential upon *p*H. It is difficult to carry out a satisfactory controlled potential reduction for this stage, but those performed indicate that the product is mainly benzopinacol with a small amount of benzohydrol. This implies that under these conditions the second electrode reaction is surprisingly slow compared with that of the polymerization. It is not at all certain yet whether benzophenone first adds an electron or takes up a hydrogen ion. Ultra-violet absorption spectra indicate the existence of an equilibrium between benzophenone and the compound formed by the addition of a proton. Comparison of solvation energies in various media, however, suggests that the electron uptake occurs first. The independence of the second wave from *p*H changes is a feature of many organic reductions, which are characterized as irreversible.

Polarography of Azo-proteins

The afternoon session began with F. J. Radcliff, of the University School of Agriculture, discussing the 'Polarography of Azoproteins'. The polarograms obtained are reproducible with an accuracy of from 3% to 5%. It is intended to apply the polarography of azoproteins to a study of the kinetics of the antigen-antibody reaction.* Investigations of the phenomena of dye absorption on protein surfaces have been undertaken. It is intended to develop these lines of research for clinical tests for specific immunity.

* It has since been possible to examine the effect of the addition of specific antiserum to azoprotein solutions. This causes a sharp decrease of the polarographic azoprotein step, and the method is now being developed to enable quantitative polarographic measurement of the antigen-antibody reaction.

Polarography of Iodo Compounds

Dr. Edith Gergely, of the Department of Chemistry, University of Sydney, described her work on the 'Polarography of Organic Iodo Compounds'. For a series of iodo compounds, such as iodo benzene, iodo toluenes, and iodo naphthalenes, the half-wave potentials proved to be independent of the *p*H of the solution. Iodo acids and the iodo anilines, however, have half-wave potentials changing with the *p*H of the supporting electrolyte. For the *p*H-independent reductions the following mechanism has been suggested:

$$(1)\ RI + e \rightleftharpoons (RI)^{-},$$
$$(2)\ (RI)^{-} \rightleftharpoons R\cdot \times I^{-},$$
$$(3)\ R\cdot + e \rightleftharpoons R^{-},$$
$$(4)\ R^{-} + H_2O \rightleftharpoons RH + OH^{-}.$$

The addition of an electron is the potential-determining step.

The half-wave potentials of the *p*H-independent aromatic iodo compounds are in the order of $-1{\cdot}4$ volt to $-1{\cdot}7$ volt *vs* S.C.E. The shifts of the half-wave potentials by introducing different substituents into iodo benzene could be explained by the Pauling-Wheland electron-density theory with the assumption that the addition of an electron, and consequently the reduction, will occur at the lower potential the greater the electron affinity of the carbon atom to which the iodine atom is attached. In the reduction of the *p*H-dependent iodo-acids and iodo-anilines the hydrogen ions must play some part in the potential-determining step by enhancing the reduction of the iodo group. The reduction potentials of both ortho iodo benzoic acid and ortho iodo aniline are as low as $-1{\cdot}0$ volt *vs* S.C.E. in buffers of *p*H 1·2, and increase with increasing *p*H up to $-1{\cdot}64$ volt and $-1{\cdot}53$ volt respectively at *p*H 8. In case of the meta and para iodo benzoic acids the half-wave potential difference in the acid and alkaline media is not so pronounced. A possible explanation for the action of the hydrogen ions would be an internal H-bond formation which would be expected to be strongest when the NH_2– or the –COOH group is in ortho position to the reducible iodo group.

Polarography and Theoretical Chemistry

The last paper was read by L. E. Lyons, of the Chemistry Department, University of Sydney, who pointed out two relations between polarography and theoretical chemical calculations. First, the polarography of substituted aromatic compounds revealed a shift in the half-wave potential with substitution, and this shift could be correlated with a calculated shift with substitution in the level of the first unoccupied molecular orbital using a first-order perturbation theory. A calculated shift in half-wave potential was 39 mV and the observed shift was

30 mV for a methyl-substituted quinolinium ion. Secondly, by putting $E = \chi - A - S$, it has been possible to calculate the electron affinities, A, of aromatic hydrocarbons, from the absolute potential, E, of the reduction, the photoelectric work function, χ, of mercury and the solvation energy, S, of the ion formed. E is obtained from the measured half-wave potential, χ is known, and S is calculated from a modified Born equation. Triphenyl methyl is the only compound for which an electron affinity value is reported in the literature, and in this case the value of 2·62 eV obtained by the present method compares with 2·56 and 2·09 eV from the literature. Qualitative support for the values obtained is that arrangement of the hydrocarbons in order of electron-affinity parallels the order according to the ease of addition of alkali metals. Benzene alone of all the molecules considered had a negative electron affinity (−0·4 eV). Other values obtained were diphenyl 0·7, naphthalene 0·7, stilbene 1·3, pyrene 1·2, 1:4-diphenylbutadiene 1·5, anthracene 1·4 and triphenyl methyl 2·6 eV.

Governmental Support of Science

THE following letter was written, on 16 October 1945, to Dr. A. N. Richards, of the United States' Committee on Medical Research. It is published with permission.*

Dear Dr. Richards,

On October 8th I wrote you a letter in answer to yours of September 26th. I felt that I could not properly reply to your questions without indicating something of my views regarding the administrative objectives and the organizational pattern of government support of science and also regarding the interrelations between the natural and the medical sciences. I limited my statements, however, to their specific bearing upon the questions raised in your letter.

On October 9th I received your telegram requesting my 'views concerning desirability, character of organization, and conduct of a post-war governmental research foundation such as is envisaged in the Kilgore and Magnuson bills'. I think that you know many of my opinions, but I shall try to recapitulate them briefly:

1. Clearly the direction which our national economy is taking is making it necessary for the Federal Government to make certain that there is more support for scientific research than was available in the pre-war period.

2. Government support of science in the pre-war period was through such agencies as the laboratories of the Departments of Agriculture and Commerce, the Bureau of Standards, the Bureau of Mines, the Army and Navy, and the Public Health Service. The objectives of the research carried on in such laboratories were for the most part limited. The quality varied considerably, as is inevitable, with the director. However, the organizational pattern and the atmosphere of such laboratories at their best is on the whole to be compared rather with industrial laboratories than with institutes created and maintained for the exploration of the phenomenal world.

3. Government support of science during this war, through such agencies as the Office of Scientific Research and Development, was also aimed at specific objectives. The success of many of the undertakings depended, in my estimation, upon the fact that both the members of the committees and the responsible investigators were scientists with a long tradition of the freedom necessary to ensure the exploitation of even a tactical advance, and able to communicate with each other in a common language. When the effort is made to increase efficiency or administrative responsibility by interposing scientific administrative officers who are the peers neither of the committee members nor the investigators, the system degenerates. Administrators at this level inevitably tend to become bureaucratic and will be increasingly imported from those who fail as creative scientists, especially if they are paid in any way for their services. When such men have an influence, policies cannot in the long run differ appreciably from those of the government agencies referred to in (2) above.

4. Creative scientific research depends upon the imagination and technical resourcefulness of the investigator. He can be chosen by a committee competent to judge of his quality. He cannot be directed.

Recognition of the implication of observations is the essential element in the creation of a scientific structure. The government, by supplying the funds to make administrators or applied scientists from creative investigators, could stultify and impede our national scientific progress. Loss of the essential observation would not be repaid by the more rapid exploitation of observations already made. Only in so far as a national scientific foundation can ensure the freedom of research at its highest level will it in the long run enrich our national life and our national economy.

5. A national foundation which derives its funds from Congress must in the long run be responsible to it. The Congress has no experience, however, and cannot be expected to acquire judgement, in the wise expenditure of funds for scientific research, without decades of experience. The inevitable tendency will be the selection of problems rather than men, a tendency which leads, as we have already seen, in many private institutions, to a pattern which represents the past but not the future. Every attempt to prepare a blueprint dividing

* By courtesy of Dr. I. W. Wark, C.S.I.R.O. Division of Industrial Chemistry.

the essential unity of science is predestined to failure. Scientific advances have a way of being made at the interfaces of the arbitrary divisions of learning, which may have a passing convenience for teaching but have no place in a pattern for research.

Two artificial ways of subdividing learning are in current use. One divides the study of the universe into astronomy and geology, oceanography and biology. The other is based upon the laws regarding this universe that have been thus far apprehended: mathematics and physics and chemistry. (I am not yet prepared to add human relations to these disciplines.) The known interfaces are also of two kinds, mathematical-physics and astrophysics being examples.

Research must be unimpeded by divisions or division chiefs. Perhaps the most important barrier impeding medical research is the barrier separating the clinician, with his insight into the range of phenomena associated with disease, from the chemist, with his insight into molecular structures and interactions. There should be no barrier separating research in the medical and natural sciences. The investigator must be free to employ the tools of mathematics or physics, physical chemistry or organic chemistry, either in exploration in the area where new observations appear promising or in the experimentation necessary to reduce the observation to practice.

6. The basis of the stability of our government is the balance between the Congress and the Executive. An administration which is not responsible to a representative government unquestionably can operate more expeditiously and with greater independence for a limited period of time. This has been demonstrated by the independent agencies that have functioned during this war. The freedom of the administrators, in the independent agencies, from a body competent to review their decisions, would introduce a pattern which is being discarded in other branches of government, now that the emergency is over, and should be discarded also should the Congress determine to continue the support of scientific research in the post-war world.

Neither the President, nor a director appointed by the President, nor the Congress, can have (I believe) the experience to judge of the wisdom of nomination to, or of policies of, a national science foundation. The administration and the Congress would be subject to political pressure to accept advice regarding science or scientists.

The Congress created the National Academy of Sciences during President Lincoln's administration, to advise the government in precisely this area. If the National Academy of Sciences has become unpopular in certain circles in Washington, this may well depend in part upon the functions that it has thus far had to perform, but in part also upon having maintained a tradition of freedom from political pressure. Though, like the Congress, the National Academy of Sciences is too large to carry on administration, it is my hope that, if a national science foundation is created by the Congress, nomination of its officers to the President, and review of its policy, may be vested in the National Academy of Sciences as the body of scientists historically charged with the responsibility of advising the government on scientific matters.

Very sincerely yours,
EDWIN J. COHN.

The International Union of Scientific Radio (U.R.S.I.)

A BRIEF description of the proceedings of U.R.S.I. at its Eighth General Assembly in Stockholm was recently published in This JOURNAL (This JOURNAL, *11*, 200, 1949). At this Assembly, Australian physicists were asked to shoulder an important part of the Union's work. Dr. D. F. Martyn was appointed President of the new Commission on Extra-Terrestrial Radio, and Dr. J. L. Pawsey its Secretary. The Union prepares a special report every two years on a subject of current interest in radio research. The subject chosen at Stockholm was 'Tidal Phenomena in the Ionosphere', a topic much studied by the Australian Radio Research Board since the war. A committee consisting of W. J. G. Beynon, S. Chapman, K. Weekes (England); J. Egedal (Denmark); A. G. McNish (U.S.A.); with D. F. Martyn (Australia) as Chairman, was set up to prepare the Special Report on this subject for publication in 1950.

The IX General Assembly of the Union will be held at Zurich in September 1950.

The National Research Council set up an Australian National Committee of Radio Science (A.N.C.O.R.S.) early in 1949. A list of the members of the Committee appeared in This JOURNAL (*12*, 101, 1949). The Committee has met twice, in June 1949 and January 1950. At its first meeting it appointed sub-committees to deal with the work of each of the seven Commissions of U.R.S.I., and arranged to hold a radio conference in Sydney in January 1950. It also decided to explore the possibilities of inviting the Union to hold its X General Assembly in Australia in 1952. Subsequent negotiations between the Secretary of A.N.C.O.R.S. and the President of U.R.S.I. (Sir Edward Appleton) showed that there would be financial difficulty in bringing a full Assembly to Australia, but Union officers have suggested that a meeting of two Commissions in Australia (those on the Ionosphere and Extra-Terrestrial Radio) would be likely to be well attended by scientists from overseas. The Australian National Committee has empowered its delegate to the forthcoming Zurich Assembly to negotiate for a meeting in Australia of these two Commissions late in 1951.

U.R.S.I. holds its Assemblies every two years, while other International Unions which deal with problems of common interests—the Union of Geodesy and Geophysics, and the Astronomical Union—meet every three years. It would be of great advantage to remote countries like Australia if these three Unions were to meet in the same year, so that strong delegations could attend each meeting with a minimum of time and expense in travelling.

At the instigation of A.N.C.O.R.S., the Australian National Research Council have drawn the attention of the Royal Society's Committee on International Relations to this point, which the Australian delegation also has been instructed to press at the Zürich Assembly. A difficulty is that U.R.S.I. finds it convenient to assemble concurrently with C.C.I.R. (Comité Consultatif d'Internationale Radiotélégraphie) a body which has strong financial backing from the various governments, since it is concerned with practical problems of radio communications. This latter body necessarily meets every two years, since it, in turn, has advisory responsibilities to C.C.I.F., the body charged with allocating radio wavelengths throughout the world.

A.N.C.O.R.S. held its first radio conference in Sydney on 16-20 January 1950. A main object was to decide upon the Australian scientific contributions to the Zürich Assembly. Some 33 papers were read and discussed, the speakers and subjects being as follows:

Commission I: MEASUREMENTS AND STANDARDIZATION.
- No papers.

Commission II: TROPOSPHERE AND WAVE PROPAGATION.
- A recording pressure variometer for the study of small atmospheric oscillations. D. F. Martyn.

Commission III: IONOSPHERE AND WAVE PROPAGATION.
- The treatment of ionospheric data for geophysical investigations. Professor S. Chapman.
- Comparison of the Chapman-Bartels and the Chapman-Miller methods of harmonic analysis as applied to ionospheric data. W. L. Price.
- Some principles involved in world-wide oscillations of the upper atmosphere. D. F. Martyn.
- Location of the ionospheric currents causing the lunar magnetic variations. D. F. Martyn.
- Travelling disturbances in the ionosphere. G. H. Munro.
- Cellular atmospheric waves in the ionosphere. D. F. Martyn.
- Moon echoes and transmission through the ionosphere. F. J. Kerr and C. A. Shain.
- Some theoretical implications of magnetic storms. Professor S. Chapman.
- Morphology of ionospheric disturbance associated with magnetic activity. D. F. Martyn.
- Anomalous magnetic variations near the equators (a new theory). D. F. Martyn and W. G. Baker.
- The E_s region at Brisbane. R. W. McNicol and G. de V. Gipps.
- Ionospheric forecasting errors in electron-limited circuits. A. L. Green and M. Harrison.
- The red and green auroral lines. R. v. d. R. Woolley.
- Variations in phase path of ionospheric echoes. G. H. Munro, C. B. Kirkpatrick and J. A. Harvey.

Commission IV: TERRESTRIAL ATMOSPHERICS.
- Observations of thermal radiation emitted by the ionosphere. J. L. Pawsey and L. L. McCready.

Commission V: EXTRA-TERRESTRIAL RADIO NOISE.
- Galactic radiation at radio frequencies: 100 mc/s survey, J. G. Bolton; 200 mc/s survey, C. W. Allen.
- The discrete sources. J. G. Bolton.
- Galactic structure. J. G. Bolton.
- The origin of galactic radio-frequency radiation. J. H. Piddington.
- Radio-frequency radiation from the quiet sun. S. F. Smerd.
- Eclipse studies of distribution of radio emission from the solar disk. W. N. Christiansen.
- Equivalent path and absorption for electromagnetic radiation in the solar corona. J. C. Jaeger and K. C. Westfold.
- Some characteristics of non-thermal solar radiation at metre wave-lengths. Ruby Payne-Scott.
- The spectrum analysis of solar bursts at metre wave-lengths. J. P. Wild.
- International co-operation and the publication of solar radio-noise information. C. W. Allen.
- Proper fields for radio astronomy. J. L. Pawsey.

Commission VI: WAVES AND OSCILLATIONS.
- Some aspects of growing waves. Professor V. A. Bailey.
- The growth and escape of plane-polarized waves from the neighbourhood of a bipolar sunspot. R. F. Mullaly.

Commission VII: ELECTRONICS.
- Dielectric properties of long-chain aliphatic compounds. J. S. Dryden.
- A decimal counter vacuum tube. D. L Hollway.

A.N.Z.A.A.S. Brisbane Meeting 1951

THE following appointments have been made for the Twenty-eighth Meeting of the Australian and New Zealand Association for the Advancement of Science, to be held in Brisbane during the week from 23 to 30 May 1951.

President: A. B. Walkom, D.Sc.

President-Elect: Sir Kerr Grant, M.Sc., F.Inst.P.

Vice-Presidents: Professor Sir Douglas Mawson, Sir David Rivett, Patrick Marshall.

Honorary General Secretary: Professor N. A. Burges, Science House, 157 Gloucester Street, Sydney.

Honorary General Treasurer: Professor J. R. A. McMillan.

Local Honorary Secretary for the Brisbane Meeting and Local Secretary for Queensland: Professor D. A. Herbert, University of Queensland, Brisbane.

Local Secretaries: N.S.W., Professor N. A. Burges, 157 Gloucester St., Sydney; Victoria, E. R. Pitt, C.S.I.R.O. Informa-

tion Service, 425 St. Kilda Rd., Melbourne; South Australia, R. S. Burdon, University of Adelaide; Western Australia, Professor A. D. Ross, University of Western Australia, Nedlands; Tasmania, Professor S. Warren Carey, University of Tasmania, Hobart; New Zealand, Gilbert Archey, Auckland Museum.

Section A. *Astronomy, Mathematics and Physics (including Optometry).*
President: Professor K. E. Bullen, University of Sydney.
Secretaries: R. D. Malcolmson, University of Queensland; L. W. Luckins, Jr., T. and G. Buildings, Brisbane (Optometry).

Section B. *Chemistry.*
President: Professor L. H. Briggs, Auckland University College.
Secretaries: M. D. Sutherland, University of Queensland; K. R. McNaught, Shell Co. of Australia Ltd., Brisbane.

Section C. *Geology.*
President: D. E. Thomas, Geological Survey of Victoria, Melbourne.
Secretary: O. A. Jones, University of Queensland.

Section D. *Zoology.*
President: Gilbert Archey, Auckland Museum.
Secretary: Miss Dorothea Sandars, Queensland Institute of Medical Research, Herston Rd., Valley, Brisbane.

Section E. *History.*
President: Professor A. H. McDonald, University of Sydney.
Secretary: A. A. Morrison, University of Queensland.

Section F. *Anthropology.*
President: Professor A. A. Abbie, University of Adelaide.
Secretary: Arthur Wade, Shell House, Ann St., Brisbane.

Section G. *Economics, Statistics and Social Science.*
President: Professor L. F. Giblin, The Treasury, Canberra.
Secretary: W. R. Lane, University of Queensland.

Section H. *Engineering Science and Architecture.*
President: Professor Denis Winston, University of Sydney.
Secretary: G. H. Francey, University of Queensland.

Section I. *Medical Science and National Health.*
President: J. E. Caughey, Auckland Hospital.
Convener: Associate-Professor H. J. G. Hines, University of Queensland.

Section J. *Education, Psychology and Philosophy.*
President: H. T. Parker, Department of Education, Hobart.
Secretary: G. F. K. Naylor, University of Queensland.

Section K. *Agriculture and Forestry.*
President: Professor E. J. Underwood, University of Western Australia.
Secretaries: Professor L. J. H. Teakle, University of Queensland; C. W. F. Pohlman, Sub-Department of Forestry, Brisbane.

Section L. *Veterinary Science.*
President: Professor R. M. C. Gunn, University of Sydney.
Secretary: A. K. Sutherland, Animal Health Station, Yeerongpilly, Brisbane.

Section M. *Botany.*
President: B. J. Grieve, University of Western Australia.
Secretary: G. L. Wilson, University of Queensland.

Section N. *Physiology.*
President: F. C. Courtice, Kanematsu Institute, Sydney Hospital.
Secretary: J. O'Hagan, Red Cross Society, Brisbane.

Section O. *Pharmaceutical Science.*
President: Professor R. H. Thorp, University of Sydney.
Secretary: V. Barnett, Kintore St., Annerley, S.3, Brisbane.

Section P. *Geography.*
President: Colonel L. Fitzgerald, Victoria Barracks, Melbourne.
Secretary: Lt.-Col. P. V. O. Fleming, Church of England Grammar School, East Brisbane.

N.S.W. University of Technology: Council and Staff

The Council

President of the University

Wurth, W. C., C.M.G., LL.B., Chairman of the Public Service Board of N.S.W.

Vice-President

Harman, R. W., M.Sc. (N.Z.), D.Sc. (London), Senior Executive Officer of the Colonial Sugar Refining Co. Ltd., Director of Courtaulds (Aust.) Ltd.

Members of Council

Clancy, The Hon. J. S. J., LL.B., Justice of the Supreme Court of N.S.W.

Clegg, W. E., General Manager of the Commonwealth Steel Co. Ltd.

Conde, H. G., Manager of the Electric Light and Power Supply Corp. Ltd.

Denning, A., B.Sc., Director of the University.

Finnan, The Hon. F. J., Minister for Labour and Industry and Social Welfare in N.S.W.

Glasheen, J. P., Assistant Director of the Department of Technical Education, N.S.W.

Harrison, R. C., Assistant Supervisor of Technical Trades at the Sydney Technical College.

Kett, W. G., Director, Mark Foys Ltd.

King, The Hon. R. A., Secretary of the Labour Council of N.S.W.
Kirby, J. N., Managing Director of James N. Kirby Pty. Ltd., Technical Director of Nuffield (Aust.) Pty. Ltd. and International Products Ltd.
Laurie, W. R., B.Arch. (Sydney), Architect.
MacDougall, J. K., Manager of Rylands Bros. Ltd., Newcastle.
Maloney, The Hon. J. J., Research Officer of the Labour Council of New South Wales.
Mathews, F. M., B.E., Assistant Chief Engineer of Australian Iron and Steel Ltd.
McKenzie, J. G., B.A., B.Ec., Director-General of Education in N.S.W.
Parry-Okeden, R. G. C., Managing Director of Lysaghts Works Pty. Ltd.
Riddell, P. D., formerly Director of Technical Education in N.S.W.
Roberts, S. H., M.A., D.Sc., Litt.D., Vice-Chancellor of the University of Sydney.
Thomas, G. B., LL.B., B.Sc., B.E., Barrister-at-Law.
Webster, R. J., Chairman of Directors and Managing Director of Burlington Mills (Aust.) Ltd., Managing Director of Bradford Cotton Mills Ltd.
Wilson, F., Director of Howie Moffatt and Co. Pty. Ltd.

With the addition of representatives elected by the teaching staff, the undergraduates and the graduates of the University.

Professors*

Applied Physics: *N. F. Astbury*

Professor N. F. Astbury, M.A. (Cantab.), served with the National Physical Laboratory for ten years from 1929, mainly upon the establishment of fundamental units of inductance and resistance. During the war he led a research group and worked on problems of harbour defence with the Anti-Submarine Experimental Establishment. He then became Director of Research with Joseph Sankey and Sons Ltd., Bilston, where he developed a laboratory which became the centre of research for the group of firms controlled by Guest, Keen and Nettlefold Ltd. He has initiated work in the fields of magnetic measurements, X-ray and mechanical studies of oriented material, application of electronics to chemical analysis, microhardness testing, and statistical applications.

Architecture: *F. E. Towndrow*

Professor F. E. Towndrow was Senior Architect to the Ministry of Works, London, and Controller of Experimental Building Development. He is a member of the Council of the Town and Country Planning Association, London; he was a member of the Building Research Board of Great Britain and was Assistant Principal to the Polytechnic School of Architecture, London. For several years he was Honorary Secretary of the Arts Committee of the Royal Institute of British Architects. Professor Towndrow at the time of his appointment was Head of the Department of Architecture at the Sydney Technical College, and Vernon Memorial Lecturer on Civic Architecture at the University of Sydney. He is a holder of the Indian Frontier Medal.

Electrical Engineering: *H. J. Brown*

Professor H. J. Brown, B.Sc., B.E. (Sydney), after a period of research with Amalgamated Wireless (Australasia) Ltd., and experience as electrical engineer with the Tasmanian Hydro-Electric Commission, joined the C.S.I.R. and was one of the leaders in radar research and development. In two visits to America and England he studied research and manufacturing developments in electrical engineering and communications. In 1945 he developed a programme of radio and radar aids for civil aeronautics, working with the C.S.I.R. and the Department of Civil Aviation. At the time of his appointment he had been for two years Acting Assistant-Director of the University and Co-ordinator of Research in the Department of Technical Education, N.S.W.

Professor Brown will be responsible for the co-ordination of research in the University.

Mining Engineering: *D. W. Phillips*

Professor D. W. Phillips, B.Sc. (Wales), Ph.D. (Cantab.), served in England as mining engineer and geologist with the Safety in Mines Research Board, of which he became Principal Scientific Officer. Upon the nationalization of the industry he was appointed Chief Safety Engineer to the National Coal Board. He has directed research on problems of haulage, subsidence, roof-control and shot-firing, and has studied methods employed in Holland, Belgium and America.

Applied Chemistry: *A. E. Alexander*

Professor A. E. Alexander, M.A., B.Sc. (Reading), Ph.D. (Cantab.), was awarded the Ramsay Memorial Fellowship in 1937 and the Rockefeller Travelling Scholarship in 1939, when he worked under Professor T. Teorell at Uppsala. He was Tilden Lecturer of the Chemical Society in 1947. He lectured at Mt. Sinai Hospital, New York, in 1948, upon the application of surface chemistry to biological problems, and addressed the Colloid Science Symposium at the Massachusetts Institute of Technology. During the war he worked with the British Ministry of Aircraft Production and with the Petroleum Welfare Department. He was engaged upon problems such as aluminium soaps; the camouflage of grass on aerodromes to resemble other countryside features; camouflage of water by films of coal-dust and oils; rubber substitutes, particularly in connexion with the oil-incendiary bomb and with flame-thrower fuels.

* The following chairs have been added:
Mechanical Engineering;
Nuffield Mechanical Engineering Research;
Metallurgy;
Humanities;
and an Associate-Professorship in Metalliferous Mining, to be situated at Broken Hill.

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

August, 1950

EDITOR: STEPHEN J. COPLAND, c.o. Linnean Society of N.S.W., Science House, Gloucester Street, Sydney.

Vol. 28 **No. 2**

ENTOMOLOGY.
(Continued.)

15272. **Hardy, G. H.** On Classifying Asilidæ. *Ent. Mo. Mag.*, lxxxiv, May **1948**, 116–119, tfs. 1–7.—The author shows that the formation of tribes may be developed largely upon the form of the prothorax (involving the more gradual separation of the prosternum from the pronotum), together with certain visible characters of the terminalia. A key is given for the tribes, and a new tribal name, Xenomyzini, is proposed to include the genus *Xenomyza* Wiedemann, 1817.

15273. **Hardy, G. H.** The Genus Tabanus in Australia. *Proc. R. Soc. Q'land*, lviii (9), issued sep. Sept. **1948**, 169–178.—Gives keys to the subgenera and species. *Tabanus gentilis* subsp. *imminutus* subsp. nov. for the form referred to as *T. gentilis* by Taylor and by Fuller, from N.S.W.: Armidale, Dorrigo and Barrington Tops; V.: Ararat. *T. particæcus* new name for *T. pallipennis* Ferg. and Hill, 1920, nec. Macquart, 1846.

15274. **Hardy, G. H.** Miscellaneous Notes on Australian Diptera. xiv. Venation and other Notes. *Proc. Linn. Soc. N.S.W.*, lxxiii (5–6), Jan. **1949**, 298–303, tfs. 1–6.—Asilidæ: Key to spp. of *Cyanonedys*. *Ommatius fimbriatus* nom. nov. for *O. queenslandi* Malloch, 1929, nec. Ricardo, 1913. *Blepharotes corarius* Wied., and key to spp.-group. Mydaidæ: *Diochlistus neogracilis* n.sp. Q.: Stanthorpe, key to the *gracilis* group. *Hermetia illucens* L., note, introduced.

15275. **Harrow, K. M.** A Note on the Occurrence of *Coptotermes* Nymphs in Hardwoofs from Australia. *N.Z. J. Sci. Tech.*, (B) xxix (4), **1948**, 223, fig. 1.—*C. acinaciformis* Frog.

15276. **Heinze, E.** Ueber australische Criocerinen. *Ent. Bl.*, Krefeld, xxxix, **1943**, 22–28, 5 figs.—Chrysomelidæ: *Lema rufobasalis* sp.n. Q'land. *Fide Zool. Rec.*, lxxxii, 1945 (1948).

15277. **Heinze, E.** Studien zur Kenntnis der Tribus Deretaphrini und deren Stellung im System (Colyiidæ). *Ent. Bl.*, Krefeld, xxxix, **1943**, 85–93; 97–124, 2 pls.—*Erotylathrus biroi* sp.n. Australia.

15278. **Hely, P. C.** Insect Pests. Bean Fly Control. *Agric. Gaz. N.S.W.*, lix (8), Aug. **1948**, 419–420, illustr.

15279. **Hely, P. C.** Control of Fruit Fly under Backyard Conditions. Value of Nicotine Sulphate Baits. *Agric. Gaz. N.S.W.*, lx (3), March **1949**, 143–146.

15280. **Hering, E. M.** Neue Gattungen und Arten von Fruchtfliegen der Erde. *Siruna Seva*, Berlin, v, **1944**, 1–17, 8 figs.—Trypetidæ: *Diarrhegmoides bicalcaratus* sp.n. Cape York, Q.

15281. **Hincks, W. D.** Systematic and Synonymic Notes on Passalidæ (Col.). *Ann. Mag. Nat. Hist.*, (12) ii (13), Jan. **1949**=April **1949**, 56–64, pl. v, tf. 1.—*Austropassalus* Mjöberg, **1917**, Syn. *Notocetius* Hincks and Dibbs, 1935. *A. hultgreni* Mjöberg, 1917, Syn. *N. cornutus* Hincks and Dibb, 1935, N. Q'ld.

15282. **Hindwood, K. A.** A Note on Louse-flies. *Emu*, xlvii (4), March **1948**, 303–304, pl. 21.—Hippoboscidæ on White-backed Swallow.

15283. **Hinton, H. E.** On Some New and Little-known Indo-Australian Diaperini (Coleoptera, Tenebrionidæ). *Ann. Mag. Nat. Hist.*, (11) xiv (110), Feb. 1947–Dec. **1947**, 81–98, tfs. 1–11.—*Martianus* Fairmaire, 1893, Genotype, *M. castaneus* Fairmaire, 1893, by monotypy. *M. xamiaphila* (Carter, 1920, *Alphitobius*), note. *M. deplanatum* (Champion, 1894, *Platydema*), note. *M. bicinctum* (Champ., 1894, *Platydema*), note. *M. heroni* (Carter, 1929, *Platydema*), note. *M. rubibase* (Carter, 1917, *Platydema*), note. *M. pascoei* (Macleay, 1872, *Platydema*), note. *M. semele* sp.n. N.S.W.: Richmond R.

15284. **Hinton, H. E.** Some Beetles Occasionally Introduced into the British Isles. *Ent. Mo. Mag.*, lxxxiii (1003), Dec. **1947**, 284–289, col. pl. A.—Among the 38 spp. listed is *Tristaria grouvellei* Reitt., 1878, of the family Lyctidæ, specimens having been introduced into Great Britain in cases made from Australian chestnut, *Castanospermum*.

15285. **Hinton, H. E.** A Synopsis of the Genus *Tribolium* Macleay, with some Remarks on the Evolution of its Species-groups (Coleoptera, Tenebrionidæ). *Bull. Ent. Res.*, xxxix (1), May **1948**, 13–55, tfs. 1–33.—Five species-groups are recognized. A key to the species of *Tribolium* is given, and among the new forms added are those given below. *Tribolium waterhousei* sp.n. N.S.W.: Bombala; Q.: Rockhampton. *T. antennatum* sp.n. Queensland.

15286. **Holdaway, F. G., and Gay, F. J.** Temperature Studies of the Habitat of *Eutermes exitiosus* with Special Reference to the Temperatures Within the Mound. *Aust. J. Sci. Res.*, (B) i (4), Nov. 1949, 464–493, pl. i; 12 tfs.

15287. **Hunter, R. L.** Food Plants Common to Birds and Insects. *N. Q'land Nat.*, Cairns, xv (85), Dec. 1947, 14–15.

15288. **Jenkins, C. F. H.** The Argentine Ant (*Iridomyrmex humilis* Mayr.). *J. Dept. Agric. W.A.*, (2) xxv (3), Sept. 1948, 245–258, tfs. 1–7.

15289. **Jenkins, C. F. H.** The Banana as a Host Fruit of the Mediterranean Fruit Fly. *J. Dept. Agric. W.A.*, (2) xxv (3), Sept. 1948, 263–264, illustr.

15290. **John, H.** Australische Notiophygidæ (=Discolomidæ) Col. 3 neue Species der Gattung *Aphanocephalus* Woll. *Ent. Bl.*, Krefeld, xxxvii, 1941, 191–194, 1 pl., 1 fig.—*A. hackeri* sp.n.; *A. perlucidus* sp.n.; *A. austerus* sp.n. *Fide Zool. Rec.*, lxxxii (1945), 1948.

15291. **Johnson, R. A.** Control of Termites in the Board's Properties. Part i. *Port of Sydney J.*, ii (5), July 1949, 162–165, illustr.—*Coptotermes acinaciformis* is the predominant termite. *Rhinotermes* in electric light poles.

15292. **Jordan, H. E. K.** On Some Phylogenetic Problems Within the Order of Siphonaptera (=Suctoria). *Tijds. v. Ent.*, lxxxviii, Feestbundel, 1945 (1947), 79–93, 9 tfs.—Refers to Australian genera and species.

15293. **Kapur, A. R.** On the Old World Species of the Genus *Stethorus* Weise (Coleoptera, Coccinellidæ). *Bull. Ent. Res.*, xxxix (2), Aug. 1948, 297–320, tfs. 1–75.—*S. vagans* (Blkb.), descr. Victoria. *S. nigripes* sp.n. W.A.: Albany.

15294. **Kessel, E. L.** Australian Sod Fly Introduced into California (Diptera: Stratiomyidæ). *Science*, cviii (2813), Nov. 1948, 607 (reprint pp. 1–2).—*Metaponia rubriceps* Macquart.

15295. **Lallemand, V.** Quatrieme Note sur les Cercopides. *Bull. Ann. Soc. Ent. Belg.*, lxxxii, 1946, 189–197.—*Aphrophorinella* n.g. Orthotype, *A. tonnoiri* n.sp. Tas.: Cradle Valley, Alpine Creek, Mt. Hartz; Margate; Mt. Wellington. N.S.W.: Mt. Victoria.

15296. **Lee, D. J.** Mosquitoes (Diptera, Culicidæ) Recorded from Tasmania. *Rec. Queen Vict. Mus.*, ii (2), 1948, 53–56.

15297. **Lepesme, P.** Un nouveau *Megatoma* d'Australie (Col. Dermestidæ). *Bull. Soc. ent. France*, xlvi, 1941 (1944), 142.—*M. foveolatus* sp.n.

15298. **Lesne, P.** Sur les genres *Xylogenes* et *Xylomedes* (Col. Bostrychidæ). *Ann. Soc. ent. France*, cix, 1940 (1941), 131–146, 4 figs.—*Xylogenes*. Key to spp.; *X. granulicauda* sp.n. Australia.

15299. **Lloyd, N. C.** Insect Pests. The Use of DDT to Control the Cherry Slug (*Caliroa limacina*). *Agric. Gaz. N.S.W.*, lix (10), Oct. 1948, 541–546, figs.

15300. **Lord, F. A.** Australian Moth is World's Largest. *J. Ent. Zool.*, Pomona, Claremont, Cal., xl (3), 1948, 45–46.—*Coscinocera hercules*—life history.

15301. **Lundblad, O.** Zur Kenntnis australischer Wassermilben. *Arkiv. f. Zool.*, xl (A) (1), Nr. 2, 1948, 1–82, pls. i-ix, tfs. 1–50.—The preliminary diagnoses of most of the water mites herein described in detail, appeared in the *Ent. Tidskr.*, lxii (1–2), 1941, see *Aust. Sci. Abs.* 12417; while the remainder of the descriptions concern 21 new species, three new varieties, and a new genus: *Flabellifrontipoda*.

15302. **McAreavey, J. J.** New Species of the Genera *Prolasius* Forel and *Melophorus* Lubbock (Hymenoptera, Formicidæ). *Mem. Nat. Mus. Vict.*, No. 15, Oct. 1947 (Aug. 1948), 7–27, pl. i, fig. 1.

15303. **McAreavey, J.** Some Observations on *Myrmecia tarsata* Smith. *Proc. Linn. Soc. N.S.W.*, 1948, lxxiii (3–4), 1948, 137–141.

15304. **McAreavey, J. J.** Australian Formicidæ. New Genera and Species. *Proc. Linn. Soc. N.S.W.*, lxxiv (1–2), 1949, 1–25, tfs. 1–70.—*Anochetus armstrongi* sp.n. N.S.W.: Nyngan. *Stenothorax* g.n. Orthotype, *S. katerinæ* sp.n. V.: Greensborough. *Metapone tricolor* sp.n. N.S.W.: Nyngan. *Xiphomyrmex capitalis* sp.n. N.S.W.: Nyngan. *Dacryon marginatus* sp.n. N.S.W.: Nyngan. *Monomorium* (*Holcomyrmex*) *armstrongi* sp.n. N.S.W.: Nyngan. *M.* (*H.*) *niger* sp.n. N.S.W.: Nyngan. *Schizopelta* g.n. Orthotype, *S. falcata* sp.n. N.S.W.: Nyngan. *Dolichoderus* (*Hypoclinea*) *armstrongi* sp.n. N.S.W.: Nyngan. *Camponotus* (*Myrmogonia*) *sanguinea* sp.n. N.W. Aust.: Broome. *C.* (*M.*) *armstrongi* sp.n. N.S.W.: Nyngan. *Melophorus* (*Melophorus*) *brunea* sp.n. N.S.W.: Nyngan. *Plagiolepis nynganensis* sp.n. N.S.W.: Nyngan. *Stigmacros elegans* sp.n. N.S.W.: Nyngan.

15305. **McCulloch, R. N.** Controlling Household Pests with DDT. *J. Dept. Agric. S.A.*, lii (8), March 1949, 396–398.—Substantially the same as an article by the same author which appeared in a 1947 issue of the *Journal*.

15306. **McDougall, W. A.** Investigations in the Control of Wireworms (*Lacon variabilis* Cand.) in Cane Fields with "Gammexane". *Q'ld. J. Agric. Sci.*, iv (4), 1947, 140–150.

15307. **McKeown, K. C.** Australian Insects. XXXIV. Coleoptera II.—Cryptophagidæ and Nitidulidæ. *Aust. Mus. Mag.*, ix (9), Oct.-Dec. 1948, 302–305, illustr.

15308. **McKeown, K. C.** A New Name for an Australian Cerambycid. *Proc. R. Zool. Soc. N.S.W.*, 1947–48 (1949), 37.—*Didymocantha flavopicta* nom. nov. for *D. picta* McKeown, 1948, nec. Bates, 1874, a New Zealand species.

15309. **Mackerras, I. M., and Mackerras, Mary J.** Revisional Notes on Australasian Simuliidæ (Diptera). *Proc. Linn. Soc. N.S.W.*, 1948, lxxiii (5–6), 1949, 372–405, 20 tfs.—The Australasian fauna here dealt with comprises 20 species and three subspecies from Australia and Tasmania, four from New Guinea, and seven from New Zealand. Three genera are represented in Australia: *Cnephia*, *Simulium* and *Austrosimulium*. A new subsp., *A. torrentium* subsp. *hilli*, is recorded.

15310. **Mackerras, I. M., and Pope, P.** Experimental Salmonella Infections in Australian Cockroaches. *Aust. J. Exp. Biol. Med. Sci.*, xxvi (6), 1948, 465–470, figs.

15311. **Mackerras, M. Josephine, and Mackerras, I. M.** Simuliidæ (Diptera) from Queensland. *Aust. J. Sci. Res.*, (B) i (2), May 1948, 231–270, pls. i-ii, tfs. 1–14.

15312. **Mackerras, M. Josephine, and Mackerras, I. M.** Salmonella Infections in Australian Cockroaches. *Aust. J. Sci.*, x (4), 1948, 115.

15313. **Manski, M. J.** Australian Neuroptera. *Q'land Nat.*, Brisbane, xiii (6), Dec. 1948, 114–115, pl., figs. 1–3.—*Stilbopteryx brocki* n.sp. Q.: Kalpower. Compared with *S. costalis* Newman, pl. f. 2 (stated as f. 1, in legend).

15314. **Maple, J. D. (the late).** The Eggs and First Instar Larvæ of Encyrtidæ and Their Morphological Adaptations for Respiration. *Univ. Calif. Publ. Ent.*, viii (2), 1947, i-viii, 25–122, tfs. 1–67.—This posthumous paper (the author was killed on Okinawa in April, 1945) includes descriptions of the early stages of species of Encyrtids originally described from Australia. *Anarhopus sydneyensis* Timb., *Tetracnemus pretiosus* Timb. and other forms are well-known as parasites of scales and mealy-bugs, a group of economic importance.

15315. **Marks, Elizabeth N.** Studies of Queensland Mosquitoes. Part III.—The *Aedes* (*Finlaya*) *australiensis* Group. *Univ. of Q'ld Pap. Dept. Biol.*, ii (8), 1948, 1–42, tfs. 1–17.—Six Australian species are here dealt with: *A. australiensis* (Theo.), *A. biocellatus* (Taylor), *A. auridorsum* Edw., *A. palmarum* Edw., *A. monocellatus* n.sp., and *A. subauridorsum* n.sp.; their grouping is regarded as artificial and they are not as closely related as the species of the *papuensis* group in New Guinea, which have been dealt with elsewhere by King and Hoogstraal (1946).

15316. **May, A. W. S.** The Light Brown Apple Moth. *Q'land Agric. J.*, lxvii (4), Oct. 1948, 212.—*Tortrix postvittana* Walk.

15317. **May, A. W. S.** The Control of Heliothis in Linseed. *Q'land Agric. J.*, lxviii (4), April 1949, 216–220.—*Heliothis armigera* Hbn.

15318. **May, A. W. S., and Fisher-Webster, K.** Codling Moth Control Experiments, 1947–48. *Q'land Agric. J.*, lxvii (3), Sept. 1948, 143–146.

15319 **Morgan, W. L.** Insect Pests. Control of Tomato Pests. *Agric. Gaz. N.S.W.*, lix (8), Aug. 1948, 421–422, illustr.

15320. **Morgan, W. L.** The Heliothis Caterpillar (*Heliothis armigera*). *Agric. Gaz. N.S.W.*, lix (9), Sept. 1948, 477–479, 492, illustr.

15321. **Morris, J. C. H.** The Taxonomic Position of *Idiogarypus Hansenii* (With). *Pap. Proc. R. Soc. Tasm.*, 1947 (1948), 37–41, pl. iv.—*Synsphyronus* (*Maorigarypus*) *hansenii* (With), from Risdon, near Hobart, T.

15322. **Morris, J. C. H.** A New Genus of Pseudogarypin Pseudoscorpions Possessing Pleural Plates. *Pap. Proc. R. Soc. Tasm.*, 1947 (1948), 43–47, pls. v-vi.—*Neopseudogarypus* g.n. Orthotype, *N. scutellatus* sp.n. In hills from Glen Dhu to Trevallyn, near Launceston, Tasm.

15323. **Mungomery, R. W.** Report of the Division of Entomology and Pathology. *48th Ann. Rpt. Bur. Sugar Exp. Stat.*, Brisbane, pp. 31–40, 1948.—Treats with economic insects affecting sugar-cane.

15324. **Musgrave, A.** A Catalogue of the Spiders of Tasmania. *Rec. Queen Vict. Mus.*, Launceston, ii (2), 1948, 75–91.

15325. **Musgrave, A.** Some Butterflies of Australia and the Pacific. Family Danaidæ—Danaids II. *Aust. Mus. Mag.*, ix (9), Oct.-Dec. 1948, 309–314, illustr.

15326. **Musgrave, A.** Spiders Harmful to Man. Part I. *Aust. Mus. Mag.*, ix (11), April-June, 1949, 385–388, illustr.—The position of spiders in the Animal Kingdom; poison and treatment.

15327. **Newell, I. M.** Studies on the Morphology and Systematics of the Family Halarachnidæ Oudemans 1906 (Acari, Parasitoidea). *Bull. Bingham Oceanog. Soc.*, x (4), 1947, 235–266, tfs. 1–66.—*Orthohalarachne* n.g. Genotype, *O. attenuata* (Banks, 1910); *O. reflexa* (Tubb, 1937), Lady Julia Percy Is., V.

15328. **Obenberger, J.** De Generis *Melobasis* Cast. et Gory Speciebus novis. (Col. Bupr.). *Sbornik entom. odd. Zem. Musea v Praze*, xx, 1942, 99–106.—Describes some 18 new forms (species and varieties) from Australia.

15329. **Ochs, G.** A Revision of the Australian Gyrinidæ. *Rec. Aust. Mus.*, xxii (2), 1949, 171–199.—Describes the following new subgenera and spp. *Macrogyrus* Reg., 1882, Subg. *Orectomimus* Ochs, 1930; *M.* (*O.*) *darlingtoni* sp.n. Ravenshoe, N.Q. Subg. *Tribolominus* nov. Orthotype, *M.* (*T.*) *reticulatus* Reg. Subg. *Australogyrus* nov. Orthotype, *M.* (*A.*) *oblongus* Boisd. Subg. *Clarkogyrus* nov. Orthotype, *M. reichei* Aube. Subg. *Tribologyrus* nov. Orthotype, *M.* (*T.*) *australis* Brulle. *M.* (*T.*) *angustatus* Reg. Subsp. *metallescens* nov. E. Australia. *M.* (*T.*) *finschi* Ochs. Subsp. *minor* nov. Cape York Penin., N.Q. Subg. *Megalogyrus* nov. Orthotype, *M.* (*M.*) *striolatus* Guerin. Previously known spp. are also redescribed, and a new species, *Gyrinus ahlwarthi*, from New Guinea, is described.

15330. **Oldroyd, H.** A Wingless Empid (Diptera) from Tasmania. *Ent. Mo. Mag.*, lxxxiv (1015), 1948, 278–279, tfs. 1–2.—*Apterodromia* n.g. Orthotype, *A. evansi* n.sp. Tasmania.

15331. **Pasfield, G.** Use of DDT for Thrips on Tomatoes in the Metropolitan Area. Effect on Incidence of Spotted Wilt. *Agric. Gaz. N.S.W.*, lix (11), 1948, 604–605.

15332. **Paulian, R.** Sur quelques Coléoptères coprophages récoltés par le Dr. E. Mjöberg à Borneo et en Australie. *Rev. franc. Ent.*, Paris, x, 1944, 64–75.

15333. **Rapp, W. F. (Jr.), and Cooper, J. L.** Check-list of Psychodidæ of Asia and Australia. *J. New York ent. Soc.*, liii, 1945, 211–217.

15334. **Rayment, T.** Some Bees from the Victorian Alps. *Vict. Nat.*, Melbourne, lxv (8), 1948, 201–202.

15335. **Rayment, T.** New Bees and Wasps—Part VIII. A New Species of *Exoneura*, with Notes on Other Reed-bees from the Grampians. *Vict. Nat.*, Melbourne, lxv (9), 1949, 208-212, tfs. 1-9.—*E. simillima* sp.n.; *E. obliterata* (Ckll.), redescribes type ♀, and allotype, ♂; *E. froggatti* Ckll.; *E. fultoni* Ckll.; *E. montana* Raym. New record for the State; described from Macpherson Range; N.S.W.: Patonga Beach, in a stem of lantana; *E. roddiana* Raym., new record for State; described from Sydney, N.S.W.; V.: Grampians Range, 2, 250 ft.

15336. **Rayment, T.** New Bees and Wasps—Part IX. Four Undescribed Species of *Exoneura*, with Notes on their Collection, and Description of New Parasites Discovered on the Genus. *Vict. Nat.*, Melbourne, lxv (11), 1949, 247-254, illustr.—*E. apposita* sp.n. Lane Cove, N.S.W.; *E. concava* sp.n. Brooklyn, N.S.W.; *E. marjoriella* sp.n. Brooklyn, N.S.W.; *E. variabilis* sp.n. Narooma, N.S.W.; *E. montana* Raym., from lantana, Brooklyn, N.S.W.; *E. excavata* Ckll., from lantana stems, Brooklyn, N.S.W. Family Encyrtidæ: *Aphycus asperithorax* sp.n. Brooklyn, N.S.W., parasite of *Exoneura* in lantana stems. Acarid mites on *Exoneura*.

15337. **Rayment, T.** New Bees and Wasps—Part X. *Vict. Nat.*, Melbourne, lxv (12), 1949, 271-272.—Hylæidæ: *Pachyprospis celmisiæ* sp.n. Mt. Buffalo, V. *Euryglossa catanii* sp.n. Reed's Lookout, Mt. Buffalo, V.

15338. **Rehn, J. A. G.** The Acridoid Family Eumastacidæ (Orthoptera). A Review of our Knowledge of its Components, Features and Systematics, with a Suggested New Classification of its Major Groups. *Proc. Acad. Nat. Sci. Philad.*, C, 1948, 77-139, tfs. 1-13.—Subfam. *Morabinæ* nom. nov. for *Callitala* Sjostedt, 1921, genotype, *C. major* Sjostedt. *Moraba* Walker, 1870, genotype, *M. serricornis* Walk. Subfam. *Biroellinæ* C. Bolivar, 1930, *Biroella* I. Bolivar, 1903, genotype, *B. dispar* I. Bol.

15339. **Roepke, W.** The Genus *Nyctemera* Hübner. *Trans. R. ent. Soc. Lond.*, c (2), 1949, 47-70, 2 pls., 14 tfs.—*Nyctemera* Hübn., 1820, genotype, by subsequent designation, *N. lacticinia* Cramer. *N. baulus baulus* Boisd. N. Australia; extra-limital.

15340. **Sabrosky, C. W.** The Muscid Genus Ophyra in the Pacific Region (Diptera). *Proc. Haw. Ent. Soc.*, 1948, xiii (3), 1949, 423-432.—Key to the species of the Pacific Region. *Ophyra* R.D.: regards *Australophyra* Malloch, 1923, as a synonym, and also *Peronia* R.D. 1830, which is preocc. by that of Fleming, 1822 (Mollusca). *O. nigra* (Wd.), 1830, from Q'land; N. Territory; extra-limital. *O. chalcogaster* (Wd.) from Q'land; N. Territory; extra-limital. *Hydrotæa fuscocalyptrata* Macq., note, Australia.

15341. **Schedl, K. E.** Interressante und neue Scolytiden und Platypodiden aus der australischen Region. 79. Beitrag zur Morphologie und Systematik der Scolytoidea. *Mitt. Münch. Ent. Ges.*, xxxii (1), 1942, 162-201, 2 tfs.—Describes 14 Australian species as new.

15342. **Schürhoff, P. N.** Beiträge zur Kenntnis der Cetoniden (Col.) IX. *Mitt. Münch. Ent. Ges.*, xxxii (1), 1942, 279-293.—*Ischiopsopha scheini* n.sp. Q.: Cape York. *Chlorobapta goerlingi* n.sp. W.A.: Marloo Station, Wurarga.

15343. **Schwarz, H. F.** Stingless Bees (Meliponidæ) of the Western Hemisphere. *Bull. Amer. Mus. Nat. Hist.*, xc, 1948, xviii, 546, tfs. 1-87, pls. 1-8, tabs. 1-5.—Refers to *Trigona carbonaria* F.Sm.; *T. cassiæ* Ckll., Australian spp.

15344. **Seevers, C. H.** New Genera and Species of Trichopseniinæ from American and Australian Termite Nests (Coleoptera, Staphylinidæ). *Pan-Pacific Ent.*, San Francisco, xxi, 1945, 63-72, 5 figs.—*Mastopsenius* n.g. *M. australis* sp.n. Queensland.

15345. **Silvestri, F.** Lepismatidarum (Thysanura) genus novum termitophilum ex Nova-Hollandia. Gen. *Allatelura* nov. *Tijds. v. Ent.*, lxxxviii, Feestbundel, 1945 (1947), 74-78, tfs. 1-ii.—*Allatelura* n.g. Orthotype, *A. Hilli* sp.n. Koolpunyaba, N.T., from nest of *Mastotermes darwiniensis* Frogg.

15346. **Smith, J. H., and Weddell, J. A.** Banana Rust Thrips Control Experiment, 1948. *Q'land Agric. J.*, lxviii (2), Feb. 1949, 82-85.—*Scirtothrips signipennis* Bagn. control by: DDT 2%; BHC 4%; Dust of DDT 1% and 1·5%.

15347. **Steel, W. O.** On Australian Species of *Creophilus* (Coleoptera: Staphylinidæ). *Proc. Linn. Soc. N.S.W.*, lxxiv (1-2), 1949, 57-61, tfs. 1-9.—Redescribes the three known Australian species.

15348. **Straneo, S. L.** Sui tipi del Pterostichini (Coleopt., Carabid.) Australiani della collezione Castelnau nel Museo Civico di Genova. *Ann. Mus. Civ. Stor. nat., Genova*, lxi, 1941 (1943), 83-94.—Includes new forms from Australia.

15349. **Swan, D. C., and Browning, T. O.** The Black Field-Cricket (*Gryllulus servillei* Saussure) in South Australia. *J. Dept. Agric. S.A.*, lii (7), Feb. 1949, 323-327, illustr.—This cricket swarms in some years in South Australia and may cause serious damage to pastures. An outline of its life-history and habits is given. It is shown to have a close association with black clay (rendzina) soils. Control measures advocated.

15350. **Theodor, O.** Classification of the Old World Species of the Subfamily Phlebotominæ (Diptera, Psychodidæ). *Bull. Ent. Res.*, xxxix (1), May 1948, 85-115, pl. x-xi.—*Phlebotomus* subgenus *Australophlebotomus* nov. subg. Genotype, *P.* (*A.*) *brevifilis* Tonnoir. In the list of species of the genus *Phlebotomus* of the Old World, three spp. are cited from Australia.

15351. **Thompson, G. B.** Notes on Species of the Genus *Pectinopygus* (s.l.)—(Mallophaga).—IV. *Ann. Mag. Nat. Hist.*, (11) xiv (113), May 1947 (Feb. 1948), 317-327, pl. x, tfs. 1-15.—*Pectinopygus* (*Epipelicanus*) *australis* sp.n. Host: *Pelecanus c. conspicillatus* Temminck, Australia, Victoria.

In the industrial field Professor Alexander has acted as adviser chiefly in connexion with paints, emulsions, soaps and detergents. His general field is that of colloid chemistry, surface chemistry and polymers; recently he has been concerned with the surface activity of substances on their microbiological and drug action. At the time of his appointment he was Assistant Director of Research in the Department of Colloid Science in the University of Cambridge.

Chemical Engineering: J. P. Baxter

Professor J. P. Baxter, O.B.E., B.Sc., Ph.D. (Birmingham), was awarded the Frankland Medal for investigations in Mechanical Engineering and Chemistry carried out in the University of Birmingham in 1925-28 as Priestley Research Scholar and James Watt Research Fellow. In 1928 he joined the research staff of the General Chemicals Division of Imperial Chemical Industries Ltd. and became Director of the Division in 1945. He was connected with the development of chemical products such as polyvinylchloride, 'gammexane', and organic fluorine compounds. In 1944, after research upon chemical warfare problems, and collaboration in the chemical side of the British atomic energy programme, he joined the American team at Oak Ridge and remained there until after the war. He was awarded the O.B.E. in 1945.

Registrar

Mr. J. C. Webb, M.Sc. (Wales), prior to coming to Australia, was engaged in lecturing and research in the University of Wales. Since 1946 he has been Head of the Mining Engineering Department of the Department of Technical Education in N.S.W. and has organized the new courses of mining instruction in centres of the State. In this capacity he was responsible for the establishment of the degree course in Coal Mining Engineering, together with a scholarship scheme for assistance to students. He has taken an active part in the organization of the social and sporting activities of the University.

Technical Education Advisory Council

A State Technical Education Advisory Council has been set up under the *Technical Education and N.S.W. University of Technology Act, 1949*. The Council will advise the Minister for Education on the provision and conduct of technical education in the State, having regard to the needs of the community, industry and commerce, and the co-ordination of the functions of the Department of Technical Education, the University of Sydney, the N.S.W. University of Technology, and other bodies concerned with education.

Members of the Advisory Council are:

A. Denning, Director of the University of Technology and Director of the Department of Technical Education, to be Chairman of the Council.

C. W. Anderson, President of the Labour Council of N.S.W.

S. E. Barrett, of the Granville Technical Education Advisory Committee.

F. S. Bradhurst, President of the Food Technology Association.

L. G. Burke, General President of the Wheat Growers' Union.

D. C. Campbell, of the Wool Advisory Committee.

W. E. Clegg, of the Metal Trades Employers' Association.

N. A. Esserman, Chief of the C.S.I.R.O. Division of Metrology, representing the Institute of Physics, Australian Branch, N.S.W. Division.

H. G. Ferrier, President of the Metal Trades Employers' Association.

R. C. Gibson, General President of the Primary Producers' Union.

R. C. Harrison, President of the Technical Teachers' Association.

J. Hooke, representing trades union interests.

R. P. Hooper, of the Broken Hill Technical College Advisory Committee.

J. H. Kaye, of the Technical Teachers' Association.

J. D. Kenny, of the Labour Council of N.S.W.

W. G. Kett, of the Board of Optometrical Registration and the Sydney Chamber of Commerce.

E. Langker, President of the Royal Art Society.

J. G. McKenzie, Director-General of Education.

D. McVey, of the Chamber of Manufactures.

J. K. MacDougall, of the Newcastle Technical College Advisory Committee.

R. W. Mackay, Chief Electrical Engineer of the N.S.W. Government Railways.

D. M. Myers, Professor of Electrical Engineering in the University of Sydney.

J. D. Norgard, of the Wollongong Technical Education District Council.

W. Scott, President of the Commonwealth Institute of Accountants.

A. J. Stone, President of the Diplomates Section of the Sydney Technical College Engineering Association.

J. Tainsh, Senior Assistant Director of the Department of Technical Education.

T. H. Upton, President of the Metropolitan Water, Sewerage and Drainage Board.

Miss B. S. K. Vines, of the Technical Teachers' Association.

C. Watt, of the Public Service Board.

F. Wilson, President of the Building Industry Congress.

News

'Australian Journal of Applied Science'

The Editorial Advisory Committee of the newly established *Australian Journal of Applied Science* comprises S. A. Clarke, C.S.I.R.O. Division of Forest Products; F. G. Lennox, C.S.I.R.O. Wool Textile Research Laboratories;

N. B. Lewis, Kodak Pty. Ltd., Melbourne; C. E. Moorhouse, Professor of Electrical Engineering, Melbourne; L. H. Smith, National Gas Association of Australia, Melbourne. The Editor is Dr. N. S. Noble. The *Journal*, which is one of the series now issued by the C.S.I.R.O. (314 Albert Street, East Melbourne, C.2, Victoria), will be issued quarterly, at a subscription rate of £1. 10*s*. a year. The first issue is dated March 1950.

Nuffield Foundation Dominion Travelling Fellowships

Nuffield Foundation Travelling Fellowships available to Australian graduates in 1951 will be: three Fellowships in Medicine, two Fellowships in the Natural Sciences, one Fellowship in the Humanities, one Fellowship in the Social Sciences. The purpose of the Fellowships is to enable Australian graduates of outstanding ability to gain experience and training in the United Kingdom in their chosen fields, and to make contact there with scholars working in those fields, with a view to the Fellows' equipping themselves to take up senior posts in research and teaching in Australia. The Fellowships are intended for men or women of first-rate intellectual and personal qualities, who have already shown unusual capacity to advance knowledge and teaching in one of the fields concerned. Candidates must be Australian nationals, normally between the ages of 25 and 35 years, and must be university graduates holding, preferably, a Master's or Doctor's degree, and having subsequently had a year or more of teaching or research experience on the staff of a university or comparable institution.

A Fellowship will normally be tenable for one year, but in exceptional cases may be extended for a further period of a few months. The Fellowship will provide for return travelling expenses of a Fellow between his home residence and the United Kingdom and, if he is married, similar expenses for his wife. An adequate allowance will be made for the Fellow's living and travelling expenses in the United Kingdom and for his academic fees, books and other incidental expenses, as well as a personal allowance. The total value of an award, including all travelling expenses, varies with needs and family responsibilities of the holder, but will in no case be less than £900.

A Fellow will be expected to resume residence in Australia on the completion of the Fellowship. Except with the express permission of the Trustees of the Foundation, a Fellow may not hold any other award concurrently with the Fellowship. A Fellow will be required to carry out, at centres approved by the Trustees of the Foundation, a programme of research work and training, similarly approved. Other work, paid or unpaid, may not be undertaken without the permission of the Trustees. During the tenure of the Fellowship a Fellow will not normally be permitted to prepare specifically for, or to take, examinations for higher degrees or diplomas awarded by bodies in the United Kingdom.

Applications for Fellowships to begin in 1951 should be submitted not later than 1 November 1950, to the Secretary, Nuffield Foundation Australian Advisory Committee, c/– The Australian National University, Canberra, A.C.T., from whom further particulars and copies of the form of application may be obtained.

West Australian Geological Club

At a meeting held on 31 July 1950, at the Geology Department, University of Western Australia, a decision was reached to form a club for the promotion of geological lectures, discussions and social events, to be styled the 'West Australian Geological Club'. Professor R. T. Prider was elected President and Dr. R. W. Fairbridge, Secretary. For the time being it was decided to keep meetings as informal as possible and to dispense with a constitution and subscriptions. At the first meeting an interesting talk on Alpine Nappes was given by Dr. Brunnschweiler, a graduate of Zürich, now with the Bureau of Mineral Resources. It was followed by a lively discussion. It is hoped that Dr. J. Tuzo Wilson, from Canada, will speak on geophysics at the next meeting.

International Union of Crystallography

The Second General Assembly and International Congress of the International Union of Crystallography will be held in Stockholm, Sweden, from 27 June to 3 July 1951. A local committee has been established in Stockholm under the chairmanship of A. Westgren, Vice-President of the Union, with F. E. Wickman as Secretary. Delegates to the General Assembly, which will be concerned with the formal business of the Union, will be nominated by the National Committees. (The Australian National Research Council has confirmed the nomination of A. L. G. Rees as Australian Delegate to the Assembly.) Crystallographers throughout the world are, however, cordially invited to attend the International Congress.

The programme of the Congress has not yet been decided in detail, but it will probably be arranged to include the following topics:

1. Instruments and Measurements.
2. New Developments in Structure Determination.
3. Alloy Structures.
4. Inorganic and Mineral Structures.
5. Organic Structures.
6. Proteins and Related Structures.
7. Random and Deformed Structures.
8. Ferro-electrics.
9. Morphology, Synthesis, etc.
10. Miscellaneous.

Offers of papers for consideration by the Programme Committee and suggestions for additional topics are cordially invited by the Executive Committee of the Union.

Further information may be obtained from Dr. R. I. Garrod, Defence Research Laboratories, Private Bag No. 4, P.O., Ascot Vale, W.2, Victoria.

Royal Society of N.S.W.

The Society's Medal, which is awarded to a member of the Society for a meritorious contribution to the advancement of science (which may include the administration of scientific endeavour) has been awarded for the year 1949 to Professor A. P. Elkin, in recognition of his services to the Society and his valuable contributions to the field of Anthropological Science.

Lysenko Papers in English

A collection of the basic papers by the Soviet geneticist, Trofim D. Lysenko, has been translated into English for publication by Consultants Bureau (153 West 33 Street, New York 1) under the title, *Lysenko—The Practical Agrobiologist*. The publication is on a limited, pre-subscription basis, at $12.50. Section titles are:

The Theoretical Foundations of Vernalization.
Selection and Theory of Stage Development of Plants.
Intra-Variety Crossbreeding of Self-pollinating Plants.
Two Trends in Genetics.
Intra-Variety Crossbreeding and the Mendelian 'Law' of Segregation.
Mentors—A More Potent Means of Selection.
The Michurin Theory—The Basis of Seed Growing.
Methods of Controlling Plant Organisms.
New Achievements in the Control of Native Plants.
Organism and Environment.
Natural Selection and Intra-Species Competition.
Genetics.
Experimental Sowing of Forest Belts in Clusters.

Russian Journals of Chemistry

Complete English translations of the *Journal of General Chemistry of the U.S.S.R.* and of the *Journal of Applied Chemistry of the U.S.S.R.* are now available from Consultants Bureau, 153 West 33 Street, New York 1, N.Y., U.S.A. All of the 1949 issues of the *Journal of General Chemistry* were translated and published by June 1950, and translations of later issues will appear eight weeks after their receipt in the United States. The annual subscription is $95.00. Translations of the *Journal of Applied Chemistry* will commence with the issue of January 1950, and will appear seven weeks after receipt in the United States. The annual subscription is $80.00.

Pacific Science Council

Following a decision made at the Seventh Pacific Science Congress held in New Zealand last year, there has now been established a permanent secretariat to maintain the activities of the Pacific Science Council between congresses. The office of the Secretariat will be at the Bishop Museum, Honolulu 17, Hawaii. The Executive Secretary is Loring G. Hudson. The Assistant Secretary is Miss Brenda Bishop, of Auckland.

A Standing Committee of Pacific Plant Areas is being constituted, to undertake a programme based upon recommendations made at the Seventh Pacific Science Congress and other matters that may arise before the Eighth Congress. It is proposed to extend the series of plant distribution maps begun by H. J. Lam. Those who have as yet accepted membership of the Committee are: E. D. Merrill, Arnold Arboretum, U.S.A.; H. J. Lam, Leiden, Holland; C. Skottsberg, Stockholm, Sweden; Sir Edward Salisbury, Kew, England; Pierre Dansereau, Montreal, Canada; N. A. Burges, Sydney, Australia; F. R. Fosberg, Washington, U.S.A.; G. M. Smith, Stanford, U.S.A. The Chairman is Dr. W. R. B. Oliver, 26 Ventnour St., Seatoun, Wellington, N.Z.

A Standing Committee on Crop Improvement in the Pacific Area has been appointed as follows: H. Kihara, Kyoto, Japan; W. H. Jack, Singapore; C. v. D. Giessen, Buitenzorg, Indonesia; Nemesio Mendiola, Manila, Philippines; Otto H. Frankel, Christchurch, N.Z.; H. C. Trumble, Adelaide, S.A.; T. Paltridge, Brisbane, Queensland; G. W. Robinson, Bangor, Wales; P. O. Ripley, Ottawa, Canada; E. S. Archibald, Ottawa, Canada; L. E. Kirk, F.A.O., Washington, U.S.A.; H. H. Warner, Honolulu, Hawaii; V. R. Boswell, Bureau of Plant Industry, U.S.A.; C. E. Pemberton, Honolulu, Hawaii. The Chairman is Dr. E. C. Auchter, Pineapple Research Institute of Hawaii, Box 3166, Honolulu 2, Hawaii.

The Hon. Secretary of the New Zealand Grassland Association, S. H. Saxby, Box 3004, Wellington, N.Z., advises that the Proceedings of the Association's Eleventh Conference are available. They comprise about 230 pages octavo and are priced at 15s. N.Z. currency.

South Pacific Commission

The Research Council of the South Pacific Commission met in Sydney in the second and third weeks of August 1950, at the University of Sydney. The meeting was to be attended by the four Permanent Members* of the Council and the fifteen Associate Members.† Observers from some international bodies and various scientific institutions were also present.

Centenary of the Royal Meteorological Society

On 3 April 1850, at a house near Aylesbury in Buckinghamshire, three Fellows of the

* L. G. M. Baas Becking, Deputy Chairman; E. Massal, Member for Health; H. G. MacMillan, Member for Economic Development; H. E. Maude, Member for Social Development. Secretary, Sir Peter Buck.

† *Health*: J. M. Cruikshank, J. A. C. Gray, J. C. Lepdell, J. T. Gunther, M. E. J. M. Heckenroth.

Economic Development: F. Bugnicourt, J. G. Crawford, D. R. Eden, B. E. V. Parham, K. A. Ryerson.

Social Development: E. de Bruyn, M. Grangié, F. J. Grattan, W. C. Groves, H. Hayden.

Royal Society and seven from the Royal Astronomical Society met together and decided to form a Society for the Study of Meteorology. The first Secretary, James Glaisher, was responsible for the establishment and administration of the required network of observing stations. He himself ascended in a meteorological balloon—unlike the practice of today—and is said to have reached a height of six miles taking measurements before lack of oxygen stopped him. He was succeeded by W. Marriott, whose *Hints to Meteorological Observers* provided the first authority of its kind. The Government Weather Service was instituted in 1853.

The present membership of the Society is more than 1500. Its President is Sir Robert Watson-Watt, of radar fame. The centenary celebrations centred at the Clarendon Laboratory, Oxford, and then transferred to the Imperial College of Science and Technology at Kensington, where a symposium on Atmospheric Turbulence was held. An extraordinary feature of meteorology is that, perhaps more than any branch of science, it breaks down national barriers between its practitioners, from very necessity. Scientists from all countries of Western Europe contribute to the publications and take part in the activities of the Royal Meteorological Society.

Insecticidal Fogs

Investigations are being made by the C.S.I.R.O. Division of Animal Health and Production upon the possibility of using fogs containing B.H.C., D.D.T., and other insecticides, instead of using swim dips or power sprays for the control of ectoparasites of sheep. Disadvantages of swim dips include the fouling of the dipping fluid; and the risk of infection immediately after shearing requires that another muster be made. On the other hand, the wool becomes stained and reduced in value if sheep in long wool are dipped.

The fog treatment used in the trials considerably reduced the number of adult parasites in shorn sheep. Its effect persisted long enough to destroy young forms emerging from eggs and pupae. It failed to give reasonable control of parasites in unshorn sheep. The treatment may be applied immediately after shearing and seems likely to be as effective as the methods now in use. The fog was produced by an American fog-making machine developed during the war to cover the movement of troops. Further work is to be undertaken before definite recommendations are made.

Crayfish Industry of Western Australia

The Western Australian crayfish industry, which grew rapidly during the war to an annual catch of more than a million pounds weight, represents about one-third of the fish production of the west. The catch is chiefly taken in the Abrolhos Group (coral islands and reefs some 50 miles in extent, lying about 40 miles off the coast near Geraldton), the other areas fished being coastal waters west and north of Fremantle and off Dongara and Geraldton.

C.S.I.R.O. survey (*Bulletin* 247, 1950) has established that there seems little danger of permanent depletion of the fishing grounds, although they may be temporarily overfished. It appears that the crayfish stocks are maintained by larvae hatched from eggs carried by females from large areas of coastal waters which are at present inaccessible to fishermen.

Wool Biology

There has been a tendency to doubt the economic soundness of fine-woolled Merino sheep in areas of high carrying capacity, where pasture improvement is possible, in spite of the post-war high prices for fine wool. The C.S.I.R.O. Wool Biology Laboratory, Sydney, has undertaken comparative laboratory tests of four breeds of sheep under liberal feeding. The breeds comprise Merinos, as fine-wool producers; Lincolns, at the other extreme, used mainly for meat production; Corriedale and Polwarth, which are intermediate, dual-purpose types genetically related to the Merino and the Lincoln.

All sheep were individually fed with as much water as they could drink and as much food as they could eat—the consumption of both being measured. The standard ration used was richer than highly improved pasture and good enough to allow all breeds to make their best wool growth. Results are summarized as follows:

	Lincoln	*Corriedale*	*Polwarth*	*Merino*
1. Feeding ..	100	106	130	141
2. Wool	16–12½	17–10	13½–8	12–7
3. Fleece	32/36s	50/56s	56/58s	70s
4. Fibre	10 000	20 000	33 000	49 000
5. Surface ...	11½	11	10	11½
6. Value	2/6	4/6	6/–	8/–
7. Return	£210	£405	£543	£677

1. Number of sheep supported in fat condition by the same amount of food.
2. Wool production in pounds per head; greasy and clean scoured respectively.
3. Quality number by fleece analysis. The Lincolns were slightly finer than their type; the other slightly stronger than their type.
4. Fibre population per square inch. Lincoln fibres showed greatest variation in thickness within the staple, Merinos least. Both Lincoln and Corriedale fleeces contained a proportion of 'medullated' or 'hairy' fibres which were absent from the other two. The Merinos produced by far the whitest and most attractive fleeces; the others showing discoloration, especially in warm, humid weather.
5. Body surface area in square feet. The Merinos, though much smaller in size and weight than the Lincolns, have a great wool-producing skin area because of the

many tiny wrinkles—which may be seen only when the wool is clipped closely.

6. Value of whole fleece, on a greasy basis, per pound.
7. Wool return for a given value of experimental fodder. The lower clean-wool weight per sheep with the Merino is largely offset by the smaller food consumption; the higher value of the fine wool per pound gives the Merino a threefold advantage over the Lincoln.

Field tests will check the pasture equivalent of these experimental-fodder results. The comparison is, of course, in terms of wool production alone, without taking into account the return from mutton and fat lambs. The investigation is a part of research into the main genetical and physiological differences between various kinds of sheep, with the intention of guiding selection to suit environment or market.

Hydraulics Research, D.S.I.R.

The Hydraulics Research Organization of the British D.S.I.R. was set up in 1947; its Director is Sir Claude Inglis. Pending the establishment of a research station, the work of the Organization has been done largely by arrangement with the National Physical Laboratory and the universities. A site for the Hydraulics Research Station has now been determined on the Oxford bank of the River Thames, upstream from Wallingford Bridge, 13 miles from Oxford and 16 miles from Reading. It comprises an estate of 90 acres, with a large manor house which will be used for offices, library and amenities. Additional trees and shrubs are to be planted to protect open-air models and to act generally as windbreaks. The station will include an open-air wave tank, 250 feet long by 160 feet wide, 30 inches deep, for the study of problems in waves and in coast erosion. There will be a flume five feet wide and 350 feet long, and a flow channel 12 feet wide and 350 feet long. The station is to be occupied in the spring of 1951.

The Organization has been investigating problems of the estuary of the River Forth, with the aid of a model installed in the Hydraulics Laboratory at Teddington. The major questions have been the effect upon the regime of the estuary which would be caused by the construction of embankments to enclose lagoons into which dredged material would be dumped for reclamation; of piers of the proposed Forth road bridge; of dredging round the Beamer Rock to a depth of 45 feet; of removing the Rock to the same level; and of extending the south arm of the Rosyth Dockyard. The reproduction of silting in the model has proved difficult owing to the low value of Reynold's number, so that silting investigations have had to be based largely on the past history of the estuary and an analysis of tidal currents.

A model is also being used for investigation of changes in the bed of the estuary of the Wyre, Morecambe Bay. Echo-soundings in 1948 and 1949 showed rapid movement of the deep channel across the estuary; more rapid than could be achieved in materials available for the bed of the model. For the models of the Thames and Severn estuaries, an air chamber has been designed to create tidal flow by pneumatic pressure. The desired input tide curve is marked on moving chart paper; the differences from the levels achieved are determined by an optical system and photo-electric cells; the error signal so obtained acts as an electrical voltage to drive a split-field motor which operates the controlling butterfly valve through a servo-mechanism. Hunting is overcome by adding a signal proportional to the first derivative of the error signal.

Building Research Congress

A comprehensive congress—the first of its kind—to review the rapid developments made in building science in recent years, is to be held in London, 11-20 September 1951. This is, of course, during the Festival of Britain. The congress is sponsored by the learned societies and professional institutions and by government departments, with the support of representative industrial federations. The central organization is being provided by the D.S.I.R. The congress will be run in three divisions, which will hold concurrent meetings. Various visits are being arranged.

Papers are invited from research workers in other countries. Suggested subjects include: effects of climate; lighting; acoustics; special-purpose problems; mechanization of building operations; structural design; soil mechanics; effects of climate upon durability of materials; burnt clay products; quarry mechanization; quality control. Communications should be sent to the Organizing Secretary, Building Research Congress 1951, Building Research Station, Bucknalls Lane, Garnston, Watford, Herts., England.

Australian National University

In the two years since plans were worked out by the Academic Advisory Council from England and the Interim Council in Canberra, the project of the National University has developed at a greater rate than was anticipated. In the Research School of Physical Sciences, Professor Marcus Oliphant has been appointed Director and E. W. Titterton has been appointed to a chair; both will be working in Canberra before the end of 1950. In the John Curtin School of Medical Research, two of the professors are at work in Melbourne and the third in London. Three chairs in the School of Pacific Studies have been filled—Professors Crocker and Nadel will be in Canberra by the end of 1950, and Professor Davidson will arrive early in 1951. In the School of Social Studies, Professor Sawer has been appointed and another appointment is

about to be made. Readers have been appointed in Political Science and Economic Statistics.

There are now fifteen Fellows of the National University. Fifty-six scholarships have been awarded. Fellows and scholars are engaged in work either abroad or in Australia. University House, the residential college, is partly constructed, and a beginning has been made on a housing project. Construction of the Physics Laboratory has begun and plans have been completed and approved for the Medical Laboratory. The Medical Laboratory will provide for research in pathology, physiology, chemistry, biochemistry, biophysics and microbiology.

N.S.W. University of Technology

The foundation stone of the New South Wales University of Technology was set by the Governor of the State, Lieut.-General John Northcott, C.B., M.V.O., on 25 February 1950. The Premier of N.S.W. unveiled a tablet commemorating the incorporation of the University by Act of Parliament. The Prime Minister of Australia was represented by the Minister for Defence. Other representatives present included the High Commissioner for the United Kingdom, the Minister of the Philippines, the Consul-General for Switzerland, the Chief Justice of N.S.W., and heads of churches.

The Australian National University was represented by the Chairman of the Interim Council (Professor R. C. Mills) and the Vice-Chancellor (Professor D. B. Copland). The University of Sydney was represented by the Chancellor (Sir Charles Bickerton Blackburn), the Deputy Chancellor (Mr. Justice E. D. Roper) and the Vice-Chancellor (Professor S. H. Roberts). The University of Melbourne was represented by the Vice-Chancellor (Sir John Medley), the University of Western Australia by the Vice-Chancellor (Professor G. A. Currie), the University of Queensland by the President of the Professorial Board (Professor J. J. Stable), the University of Tasmania by the Vice-Chancellor (Professor T. Hytten).

It was announced that the Nuffield Foundation had provided a grant for a Nuffield Research Professorship in Mechanical Engineering, from a total grant of £31,250 over ten years. This is the first occasion on which the Nuffield Foundation has endowed a research professorship outside of the British Isles. A sum of £15,000 has also been provided by the mining companies of Broken Hill towards the provision of senior staff in the subject of Mining Engineering.

Sydney University Centenary

The Centenary Celebrations of the University of Sydney commenced on 7 June 1950 with a public meeting in the Town Hall, Sydney. In the presence of the State Governor, the Lord Mayor presided. It was announced that the University, at the beginning of the current year, had realized all available funds and gone £210,000 beyond; that this deficit would be increased by £200,000 during the year with drastically restricted activities, but would be increased by a further £250,000 a year if return to pre-war standards and normal development were allowed—a total deficit of over £660,000 for the current year and £450,000 annually thereafter. A target of £10,000,000 endowment is an aim of the Centenary appeal.

The Director of the Celebrations, R. G. Clark, was appointed in January 1950 and has established an organization which comprises a series of committees and sub-committees functioning among the various groups interested in the University. Much of the initiative will come from these groups, co-ordinated by the Director. The Celebrations will extend over the three years, 1950-1951-1952, marking the successive stages of the birth of the University a hundred years ago. In October of 1950 it is intended to commemorate the introduction of the Act of Incorporation, and in 1951 to mark the Royal Assent thereto.

In 1950 the Celebrations will dwell upon the historical and traditional aspects of the University. In 1951 they will move to its practical functioning, making the public more aware of the service it renders. Aspects of research will be brought to the notice of the people through various media. In 1952 the climax will be celebrated in the usual manner of inviting representatives of sister institutions and holding sectional reunions and other special functions.

The Societies

Royal Society of New South Wales

July: F. P. Dwyer, N. A. Gibson and E. C. Gyarfas, The chemistry of osmium, V. The redox potentials of the tris-2:2′-dipyridyl osmium-II/III and tris-*o*-phenanthroline osmium-II/III couples; VI. The use of tris-*o*-phenanthroline osmium-II perchlorate as an internal redox indicator.

A. R. Penfold and F. R. Morrison, The essential oil of *Baeckea crenulata* De Candolle.

A. J. Lambeth, Heard Island—Geography and glaciology.

A. J. Lambeth (lecture), Heard Island.

Clarke Memorial Lecture (20 July 1950): F. W. Whitehouse, The Cambrian Period in Australia.

Royal Society of Tasmania

August: R. Hope-Johnstone, A trip to Lake Pedder.

R. Hope-Johnstone, Tasmanian architectural studies.

Royal Society of Victoria

July: E. D. Gill, Revision of McCoy's Prodromus types from the Lilydale and Killara districts, Victoria.

Susanne L. Duigan, Australian Tertiary plants.

Isabel C. Cookson (lecture), Some fossil plants in the brown coal of Yallourn.

Royal Society of South Australia

July: H. K. Fry, Aboriginal social systems.

F. M. Angel, Notes on Lepidoptera from the Northern Territory of Australia, with descriptions of new species.

August: T. H. Johnston and P. M. Mawson, Additional nematodes from Australian fish.

D. King, Geology of the Pidinga Area, Eyre Peninsula, S.A.

Royal Society of Western Australia

July: J. Shearer (presidential address), Some optical properties of concave mirrors

and their application to the X-ray microscope.

August: Professor Lily Newton (lecture), The production of agar in Britain during World War II.

Papua and New Guinea Scientific Society

August: W. Cottrell-Dormer (Director of Agriculture), Films of Malaya.

Institute of Physics, Australian Branch, N.S.W Division

June: N. F. Astbury, Some aspects of anisotropy in silicon-iron sheets.

July: W. F. Caplehorn, Nuclear forces.

August: J. F. Pearse, The physical effects of extremely high pressures.

Medical Sciences Club of South Australia

May: N. Atkinson, Observations on recent bacteriological and viral work being done abroad.

June: T. F. Quinlan-Watson, Phosphorylation.
P. Silby, Carbonic anhydrase in plants.

July: S. MacLean, Staphylococcal bacteriophages.
Mrs. Llewellyn, The adaptation of bacteria to anti-bacterial substances.

August: Sir Howard Florey, Medical research and the John Curtin School of Medicine.

Victorian Institute of Pathology and Experimental Medicine

July: T. E. Lowe, Congestion in cardiac failure.
J. D. Hicks and E. L. French, Infective processes in Hodgkin's disease.
J. B. Curtis, Rapid serial carotid angiography.
I. Heinz (demonstration), A complex teratroma.

The Journals

Letters to the Editor

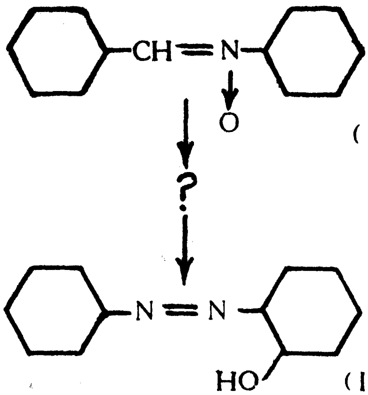
The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (a) Original Work; (b) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

A Reaction of N-Phenyl*iso*benzaldoxime

It has been reported (Alessandri, 1910) that N-phenyl*iso*benzaldoxime (I) gives 2-hydroxyazobenzene (II) and benzanilide by the action of sunlight.



(I)

(II)

Since we have been studying the reactions of N-oxides with sulphuric acid (Gore and Hughes, 1950), it seemed of interest to determine whether (I) would undergo a similar type of rearrangement to the Wallach transformation (Wallach and Belli, 1880) of its structural analogue, azoxybenzene. We have now found that (I), on treatment with 98% sulphuric acid at room temperature, gives a 20% yield (allowing for unchanged starting material) of 4-hydroxyazobenzene (III). We believe that this involves (*a*) hydrolysis to N-phenylhydroxylamine (cf. Bamberger, 1894), followed by (*b*) disproportionation with formation of azoxybenzene (cf. Bamberger *et al.*, 1898, 1900, 1912), and (*c*) a Wallach transformation.

The mode of formation of (II) is more difficult to understand, but azoxybenzene may reasonably be considered a possible intermediate, since this is known to yield appreciable amounts of (II) by the action of light (Knipscheer, 1903; Cumming and Ferrier, 1925).

Further work is being carried out on this problem and will be reported on elsewhere.

P. H. Gore.
G. K. Hughes.

School of Chemistry,
University of Sydney,
June 1950.

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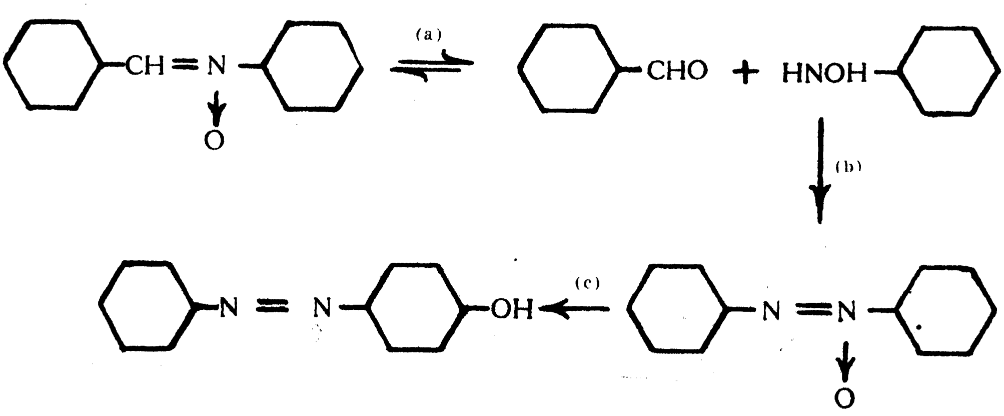
Fossiliferous Rocks of Permian Age from the Territory of New Guinea

Fossiliferous Palaeozoic rocks are known from Dutch New Guinea, but they have not been reliably recorded from anywhere east of the international boundary. A reference to a Devonian coral from the Tauri River and a report of a leaf fragment compared with *Glossopteris* are both based on Late Tertiary fossils as shown by later mapping and collecting in the areas of these discoveries.

When N. H. Fisher visited the Mt. Hagen area in 1937, in his capacity of Government Geologist of the Territory of New Guinea, he found limestones overlying the Mt. Kubor granite. They occur at the head of Gum (or Kum) Creek, about four miles south-south-east of the present Hagen air strip (5° 52′ S., 144° 14′ E.) and about two miles east-south-east of Kuta, a mining and agricultural property. These rocks were subsequently considered as Miocene, on inconclusive evidence.

During a geological reconnaissance of part of the Central Highlands of New Guinea, organized by the Australasian Petroleum Company Pty. Ltd. (and led by G.A.V.S.), this outcrop was visited and sampled, in March 1949, by one of the undersigned (K.M.L.), who found the limestones, about 200 feet thick, resting on granite in Kum Creek and continuing, separated from the granite by weathered sediments, in Mumai Creek, about 1½ miles southward. When samples of the limestones



were palaeontologically examined (by M.F.G.) the following fauna of smaller foraminifera was found: *Geinitzina* sp. (Fig. 1), *Pachyphloia*

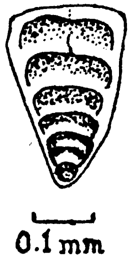


FIGURE 1.

sp., *Nodosaria* sp., *Textularia* sp., *Glomospira* sp., and indeterminate spirally coiled and chambered forms. Other samples contain small rugose corals, echinoderm, molluscan and bryozoan fragments and a small brachiopod.

The foraminifera indicate Permian age and the other fossils, as far as they are known at present, support this age determination. The fossiliferous rocks are re-crystallized limestones varying in texture from dense to gritty and pebbly. The coarser phases contain grains of quartz and felspar, and mica flakes. Quartzite occurs in close proximity to the limestone and granite outcrops. The limestones are not contact-metamorphic. The presence of quartzite and the occurrence of mica flakes, felspar and quartz grains in the fossiliferous limestones indicate that the Kubor granite is pre-Permian.

M. F. GLAESSNER.
K. M. LLEWELLYN.
G. A. V. STANLEY.

Port Moresby, Papua.
March 1950.

Connective Tissue Strands in Blowfly Larvae

Connective tissue is very inconspicuous in most insects and has often been completely overlooked. One of its main functions, namely, the maintenance of the internal organs in their correct position, has largely been taken over by the tracheae.

In some insects connective tissue is known to occur between the epithelial cells and the muscularis of the alimentary canal (Lazarenko, 1925; Riedel, 1946). Connective tissue investing other tissues, or serving to connect muscles with their insertions, has also occasionally been described (Dennell, 1942; Lazarenko, 1925; Ochsé, 1946). In view of the very few reports of long thin strands of connective tissue in insects, however, it is worth recording that the malpighian tubules of *Lucilia cuprina* are held in place not only by tracheae but also by strands which have many of the characteristics of connective tissue.

L. cuprina larvae possess two pairs of tubules. The pair discharging into the left side of the gut is modified distally for the accumulation of granules. This region shows a sharp transition to the normal type of insect tubule when it bends sharply backwards at the level of the brain (for figure see Waterhouse, 1950). Connective strands occur in several places:

(*a*) In the bend region, each anterior tubule is connected by several strands of unstriated tissue to a long fine striated muscle inserted at one end in the tip of a dorsal midgut caecum and at the other in the body wall. After meeting the bend region of the tubules, each strand runs around or along the surface of the cells for a short distance, often breaking up into finer branches.

(*b*) The blind end of each granule-accumulating region is joined by a strand of tissue to the respective blind end of the second pair of tubules. This strand is not attached to any muscle.

(*c*) The posterior half of the granule region is further held in position at four levels by unstriated strands which are attached to heart muscles. The fat body and tracheae in the vicinity of the strands may also receive fine branches.

(*d*) The second pair of tubules are attached near their blind ends to the hindgut by one or more strands.

In other muscoid larvae, striated muscles attached to the bend of each anterior tubule have been described in *Thrixion* (Pantel, (1898) and attached to the blind ends of each anterior tubule in *Drosophila funebris* (Eastham, 1925), although these latter attachments in *Thrixion* are unstriated and no striations could be seen in these strands in *D. buscki*. In *Auchmeromyia* unstriated strands join the blind ends of anterior and posterior pairs of tubules, while muscles attach each posterior tubule near its blind end to the rectum (Roubaud, 1913). The arrangement of the tubules of all of these larvae, however, is somewhat different from *L. cuprina*, so that the attachments may not actually be homologous.

The strands of tissue in *L. cuprina*, as observed with phase-contrast, polarized light, or after staining, have no cross striations, although the material comprising them is oriented longitudinally. They are less strongly birefringent than larval striated muscle; and, if mounted in turn in fluids covering a range of refractive indices, they show a variation in degree of birefringence characteristic of connective tissue, but unlike that of smooth muscle (Claesson, 1947). They stain red in van Gieson's picric-acid/acid-fuchsin, blue or purple in Mallory, and fail to stain in alcoholic orcein; all properties of connective tissue which are not shared by muscle. They have not been observed to undergo spontaneous movements,

but serve to hold the tubules in position or to return them to their position following displacement by locomotory activity or peristalsis of the alimentary canal. Because of the flexible cuticle of blowfly larvae and their type of locomotion, the internal organs tend to be displaced by these activities more than in harder bodied insects.

The unstriated strands in blowfly larvae can be regarded as connective tissue because of their properties and because smooth muscle reputedly does not occur in insects. If, however, the striated strands described in other species are homologous with the unstriated strands which occur in *L. cuprina*, there arises the difficulty that tissue which appears to be connective in one species is replaced in another by striated muscle. It is commonly held to be unusual for muscles to appear and disappear at random during evolution. In fact many of the homologies of insect morphology are based on the assumption that the position and shape of sclerites may vary but that there is relatively little change in the muscles inserted thereon. Perhaps this difficulty may be resolved by regarding the differences, if they are confirmed on re-examination, as being due to a very long or a very short length of connective tissue between the muscle and its insertion.

Any of the three available explanations for the situation in muscoid larvae ((*a*) non-homologous connectives, (*b*) the substitution of connective tissue for striated muscle, or (*c*) greatly varying lengths of connective tissue between muscle and insertion) raises interesting problems which require further investigation.

The work described in this paper was carried out as part of the research programme of the Division of Entomology, C.S.I.R.O.

D. F. WATERHOUSE.

Division of Entomology,
C.S.I.R.O.,
Canberra, A.C.T.
July 1950.

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Paper Chromatography of Nitrogen Bases

Paper chromatography has been applied extensively to the *separation* of inorganic and organic compounds. Because nitrogen bases are constituents of coal tar, work has been done on the separation of pyridine, quinoline, *iso*quinoline and collidine. A separation of these has been affected. Further work on nitrogen bases is being done with a view to elucidating the nature of coal tar oil.

The method of Williams and Kirby (1948), of ascending development, was used. Butyl alcohol (200 ml) was shaken with 2N hydrochloric acid (200 ml), the aqueous layer discarded and solid methyl red (0·5 gm) added to the solvent (Reid and Lederer). The time of ascent was approximately 24 hours, the spots appearing after drying the chromatogram in air being more intensely coloured than the background.

R_f values	(a)	(b)	(c)	(d)
Pyridine	0·19	0·18	0·21	0·21
Quinoline	0·45	0·44	0·45	0·45
*Iso*quinoline	0·42	0·42	0·41	0·41
Collidine	0·53	0·53	0·53	0·55

In chromatogram (d) a mixture of the above bases separated into three spots, two with the R_f value of pyridine and collidine, the other with an R_f value the mean of quinoline and *iso*quinoline.

A full account of this work will be published later.

Acknowledgement is made to M. Lederer (Newcastle Technical College) for his suggestions and advice, and to G. K. Hughes (University of Sydney) for supply of specimens.

W. R. WALKER.

Department of Chemistry,
Newcastle Technical College,
4 July 1950.

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Colorimetric Micro-determination of Cobalt

Benzidine and dimethylglyoxime in alcoholic solution produce a reddish-brown colour with neutral or slightly acid solutions of cobalt. In dilute solutions the Lambert-Beer law is obeyed accurately enough. Nickel and copper are precipitated by the reagent and may be removed by filtration. Iron interferes, but more than fifty parts of iron are needed to give a colour equivalent to that produced by one part of cobalt. The method is useful when reasonably pure cobalt compounds are being investigated (diffusion experiments, organic cobalt compounds, etc.).

Procedure

Benzidine (0·5 g) and dimethylglyoxime (0·25 g) are dissolved in 95% ethanol to make 100 cc. From the reagent, 5 cc are mixed with 5 cc of neutral cobalt solution and diluted to 25 cc with absolute alcohol. A mixture of 25 cc reagent, 5 cc distilled water, and 15 cc absolute alcohol is used as a blank. The intensity of the colour is measured with a Hilger absorptiometer, using 4 cm cells. Blue filters (H 455) give the best results; with a

green filter the readings are too low, and with a purple filter the colour-versus-concentration curve is not steep enough. It is best to carry out the assay one hour after producing the colour, as the intensity-versus-time change is negligible then. For approximate analysis the following table can be used:

Drum Reading.	mg Co/cc	Drum Reading.	mg Co/cc
0·05	0·001	0·80	0·019
0·10	0·002	0·90	0·022
0·20	0·004	1·00	0·026
0·30	0·006	1·10	0·030
0·40	0·008	1·20	0·035
0·50	0·010	1·30	0·040
0·60	0·012	1·40	0·044
0·70	0·015	1·50	0·051

For accurate purposes the instrument is calibrated with a standard cobalt solution diluted to 0·005% or lower concentrations (higher concentrations give unreliable results). Amounts between 20 gammas and a milligram of cobalt can be estimated with the usual microchemical accuracy.

J. B. Polya.
B. Wilson.

Chemistry Department,
University of Tasmania,
Hobart.
August 1950.

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The Occurrence of a Physiological Form of Backhousia Citriodora F. Muell. Containing Laevo-citronellal

The leaves of *Backhousia citriodora* F. Muell. contain a valuable essential oil, the principal consituent of which is the aliphatic aldehyde citral (92% to 97%). Although the natural stands of this tree (which occurs only in Queensland) are not extensive, limited quantities of the oil have been distilled and marketed.

During a recent survey, the leaves of a number of trees were found to possess an odour quite different from that of the normal oil and to contain an oil consisting principally of *laevo*-citronellal. The physical and chemical characters of this oil, together with those of a typical oil, are as follows:

	B. citriodora Type	*B. citriodora* *l*-citronellal Form
Specific gravity, 15°/15°	0·8909 to 0·9000	0·8668 to 0·8738
Refractive index, 20°	1·4859 to 1·4880	1·4527 to 1·4571
Optical rotation	Inactive to + 0·35°	– 9·8° to – 12·15°
Citral content	95% to 97%	———
Citronellal content	———	62·5% to 79·2%

Botanical specimens of the form have been carefully examined and found to be morphologically indistinguishable from the type species. It is evident, therefore, that the tree yielding *l*-citronellal is a physiological form (Penfold and Morrison, 1927) of *Backhousia citriodora* F. Muell.

The sample of *l*-citronellal isolated from one of the oils had $d_{15°}^{15°}$ 0·8555, α_D – 14·21°, $n_D^{20°}$ 1·4477, and yielded a semicarbazone m.p. 83·5° and a 2:4-dinitrophenylhydrazone m.p. 81° from ethyl alcohol.

This is the first recorded occurrence of *laevo*-citronellal in an Australian essential oil, and the optical rotation is the highest yet recorded for *l*-citronellal.

This work forms part of an extensive investigation into the incidence of physiological forms in the oil-yielding flora of Australia. A full account of these investigations will be published elsewhere.

A. R. Penfold, F. R. Morrison,
H. H. G. McKern, J. L. Willis,
M. C. Spies.

Museum of Applied Arts and Sciences,
Sydney,
9 August 1950.

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Reviews

Aerodynamics

Airplane Performance, Stability, and Control. By C. D. Perkins and R. E. Page. (New York: John Wiley; London: Chapman and Hall, 1949. 493 pp., many text-figs., 2 tables. 6″ × 9″.) Price, $7.00.

This is an excellent book which can be warmly recommended both to the student and to the aeronautical engineer who wishes to keep his knowledge up to date. It deals mainly with the application of aerodynamic data to aeroplane design. Without claiming to produce a text-book on aerodynamics the authors have succeeded in condensing the main parts of aerodynamic theory to give a clear physical picture without excessive mathematical detail. The book is a mine of useful information and well documented with references to British and American research reports. The chapters on stability and control are particularly welcome. They deal fully with static and dynamic stability and with numerous aspects of control. The complex theory of dynamic stability is presented at length and with refreshing clarity. The physical significance of stability criteria is well emphasized and the reader gets the impression that the authors combine mathematical acuity with a practical knowledge of aeroplane behaviour to an unusual degree.

The scope of the book is wide and the material well up to date. For example, aerodynamic data on supersonic wings of high sweep and low aspect-ratio is to be found.

Rocket propulsion is described, and the theory of stability is extended to cover such phenomena as the 'snaking' oscillations that have occurred on some of the latest jet-propelled aeroplanes.

This is a valuable contribution to the literature of aeronautics.

A. V. STEPHENS.

Biochemistry

SUBMICROSCOPIC MORPHOLOGY OF PROTOPLASM AND ITS DERIVATIVES. Second edition. By A. Frey-Wyssling. Translated into English by J. J. Hermans and M. Hollander. (Amsterdam: Elsevier; London: Cleaver-Hume, 1949. 255 pp., 160 text-figs., 28 tables. 10″ × 7″.) English price, £1. 12*s*. 6*d*.

This is an English translation of the second edition (1947) of an important book first published in German in 1938. The material considered is divided into three main sections: fundamentals of submicroscopic morphology, fine structure of protoplasm, and fine structure of certain special derivatives of protoplasm. The first section comprises an examination of the organization of sols and gels and an excellent treatment of the principles of structure. The second section is an account of the fine structure of cytoplasm, nucleus, chloroplasts and erythrocytes. The last section assembles the best information on frame substances such as cutin, chitin, cellulose, keratin, myosin, collagen, fibroin and the reserve substances such as starch grains and protein crystalloids. These are considered in relation to the tissue structures in which they are located.

The appearance of a new edition and a translation of this book is a reminder of the greater attention now given to questions of organization and cellular structure in biological studies. The author, Professor of General Botany in the Institute of Technology, Zurich, has drawn upon long experience and produced a stimulating and scholarly monograph. In considering methodology, the author deals with all techniques and not merely with electron microscopy, which, as he states, is the subject of several good monographs. The subject-matter is presented very clearly and supported with excellent diagrams which add greatly to its value. The book is an excellent one for the serious student who seeks an account of this branch of biology. The extensive bibliography has the useful feature of an indication of the nature of each item listed. The printing and general format also serve to give the reader a very favourable impression of the book.

J. L. STILL.

Chemistry

CHEMISTRY OF SPECIFIC, SELECTIVE AND SENSITIVE REACTIONS. By Fritz Feigl. Translated by Ralph E. Oesper. (New York: Academic Press; London: H. K. Lewis, 1949. 740 + xiv pp., many text-figs. and tables. 6″ × 9″.) Price, £4. 17*s*. 6*d*.

Thirty years ago Professor Fritz Feigl received his doctorate at the University of Vienna. He had been working under Wilhelm Schlenk, who had assigned him an analytical problem on phosphates. Feigl preferred to study the reactions now known as spot tests, his interest in this field having been initially aroused by the pioneer work of Goppelsroeder in the middle of the nineteenth century. Feigl's interest did not end with the attainment of his doctor's degree. He remained working at the University of Vienna until 1938—the year of Hitler's Anschluss—being appointed Professor of Analytical Chemistry in 1936, the researches and methods of his school becoming increasingly better known until, today, he is recognized as the founder and high-priest of spot-test analysis. Feigl was offered refuge from the Nazis in Brazil in 1940, being given a position in the Ministry of Agriculture, with complete freedom to work on whatsoever problems he desired, and being required only to lecture and publish extensively. *The Chemistry of Specific, Selective and Sensitive Reactions* is his latest effort—and a splendid one!

In this book of over 700 pages Feigl sets out to discuss the factors which underlie the analytical usefulness of chemical reactions used for the practical rapid detection of the smallest possible quantities at the highest possible dilution (sensitivity), with other materials present interfering to as small an extent as possible (selectivity), or not at all (specificity). The book is thus a text-book of the theory underlying spot-test analysis. The field it covers is necessarily very wide and the learning demonstrated by its author is immense.

The book is divided into twelve chapters. The first two are brief and definitive. The third chapter outlines the co-ordination theory, because of the very great importance of complex compounds in spot-test analysis. In the reviewer's opinion, this chapter leaves a good deal to be desired. Most English-speaking chemists would doubt the statement 'the actual nature of auxiliary valences is not known', and would consider that a more modern statement of co-ordination theory than that of Werner in 1893 could be made today. It is true that a useful list of books for further study of the chemistry of complexes is put forward by Feigl (page 28), but it is worth comment that none of Sidgwick's books is listed.

The fourth chapter of the book deals excellently with the principles underlying masking and de-masking reactions, whilst Chapter 5 deals with the enhancement of reactivity of compounds and reaction systems. The main chapter in the book, however—it requires about 200 pages—deals with the effect of certain atomic groupings on the specific and selective activity of compounds in inorganic analysis.

Here Feigl is at his best, the writing being clear and stimulating and full of suggestions for further useful work. Chapter 7 extends the consideration of the effect of certain atomic groupings to organic analysis, whilst the remaining five chapters are concerned with physical factors in analysis—such topics as solution of materials in indifferent solvents, influence of size on solubility, surface effects in analytical chemistry and the analytical use of fluorescent effects and photochemical reactions being discussed.

The book is very well printed and is of excellent material quality. Any thorough student of co-ordination theory or of modern qualitative analysis should possess a copy, for it is a real treasure-house of information. In Australia it is, perhaps, unfortunate that there are still institutions of higher learning whose chemistry schools have not yet adopted qualitative micro-analytical methods, but their introduction cannot be much longer delayed. When they are, this book of Feigl's will prove of immense value.

F. LIONS.

Colloids

THE COLLOID CHEMISTRY OF THE SILICATE MINERALS. By C. E. Marshall. American Society of Agronomy Monographs, Volume 1. (New York: Academic Press, 1949. 195 + x pp., 85 text-figs., 21 tables. 5¾″ × 9″.) Price, $5.80.

This valuable book brings together facts and theories, mostly about clay minerals, never before assembled. The data are handled critically and an independent judgment is exercised. This judgment is supported by the prestige of one who has made notable contributions in the field under review. Indeed there are, in the index, more entries under his name than under any other. We may place our own interpretations on this fact, but at least we shall remain convinced of the author's statement in regard to his own researches—'My experiences . . . have been wholly delightful'.

In fourteen chapters there are discussed the history of investigation; the structures of relevant minerals; the interpretation of clay-mineral analyses in structural terms; the size and shapes of clay-particles and the optical properties of these particles in suspensions or as aggregates; their ionic exchange and electrokinetic properties; the titration curves of clay-acids; and miscellaneous, including mechanical, properties of clays as dry films or aggregates or as physical associations with various amounts of water. The accounts of the titration curves of clays and of the properties of clay membranes are particularly useful, as much information on these matters has hitherto remained in the original literature. A point of importance is the indication provided by titration curves that cations of the same species may have differing bonding energies.

A certain eclecticism is necessary in condensing a large literature to little more than 150 pages of actual text. Thus a reviewer must, to a great extent, respect an author's personal choice of references. The present reviewer would prefer to see certain investigations mentioned, if only for the pleasure of reading the author's critical discussion of them. The reader is not informed that Edelman and Favejee have proposed an alternative structure for montmorillonite which appears to derive some support from, for instance, the unusual methylation experiments of Berger. Further, mention of Thiessen's determinations of the adsorption sites which kaolinite makes available to positively or negatively charged colloids would seem appropriate to discussions of, for instance, the possibly amphoteric character of the edges of clay flakes. The comments of Mitra and Rajagopalan are significant in this context.

It is, however, pleasing to find that the author gives due attention to anion adsorption and exchange by clays, and provides a suggestive hypothesis which links cation and anion adsorption with crystal structure. The reviewer thinks that the work of Macey on the aqueous conductivity of clays, and still more his work on their mechanical properties, could be usefully mentioned. In the chapter treating the deformation of clays, the existence of a yield-point is implied. Macey showed that plastic clay deforms under the slightest stress but continuous deformation is inhibited by shear-hardening. Shear-hardening could be overcome by a sufficiently high stress, and in this sense a yield-point could be postulated.

The bibliography is extensive and the full titles of the references are given. The literature is covered into 1948. There are a few accidental errors in the references; still fewer in the actual text. The illustrations are generally good and clear, but the numerous electron photomicrographs fall below modern standards and are often marred by a lack of any adequate indication of the magnifications used. The book is well printed and strongly bound.

In summary, this work can be unreservedly recommended. It may be expected to make its way wherever colloidal silicates are studied.

W. O. WILLIAMSON.

Cybernetics

GIANT BRAINS, OR MACHINES THAT THINK. By E. C. Berkeley (New York: John Wiley; London: Chapman and Hall, 1949. 270 pp., numerous text-figs. and tables. 5¾″ × 8¾″.) Price, $4.00.

The ability of a machine to remember was possessed by James Watt's steam engine. It would remember to turn a shaft at a certain

speed as long as the throttle valve was left in a given position. An automatic turret lathe remembers a number of instructions and carries them out with 'guards-like' precision when set up to make a screw. A gauging machine can discriminate, accept and reject. The automatic calculating machine can also remember, carry out instructions, discriminate and obey certain laws of logic. It is questionable, however, as to whether these capabilities indeed justify the title 'brain' in little more than the metaphorical sense.

Although the author very appropriately emphasizes the similarity of certain processes in a calculating machine with those of a human brain, he rather over-indulges his thoughts on their inherent capacity for good or evil. The advent of the calculating machine may have profound effects on human society; but surely no more so than the effects of, say, steam engines, radio or atomic furnaces.

With this controversial though stimulating background the author proceeds to review the now comprehensive field of calculating machines. He discusses the methods of number representation for both analogue and digital machines and explains the logic of arithmetical operations.

The greater portion of the book is devoted to a description of the principles of operation of the mechanical and electrical devices that represent and manipulate numbers. In addition, a brief account is given of the more important large-scale American calculators that are in operation today. These include Punch-Card Calculating Machines; Massachusetts Institute of Technology's Differential Analyser No. 2; Harvard's I.B.M. Sequence Controlled Calculator; Moore School's Electronic Numerical Integrator and Calculator; and the Bell Laboratories' General Relay Calculator.

Perhaps the most important unit of the modern digital calculator is its high-speed large-capacity memory. The author devotes considerable space to explaining the various novel devices used for this purpose, such as electrostatic storage tubes, acoustic delay lines and magnetic drums.

The book, though elementary, provides a very complete and stimulating approach to this rapidly expanding new branch of technology.

W. R. BLUNDEN.

History of Science

THE LIFE OF SCIENCE. Essays in the History of Civilization. By George Sarton. (New York: Henry Schuman, 1948. 197 pp.) Price, $3.00.

'The Life of Science Library', which is intended for a wider circle of readers to spread an understanding of the historical development of science, does not 'speak the language of scholars.' George Sarton, however, the great scholar and devoted protagonist of the history of science, is the author of this, its first volume. The most valuable and highly welcome collection of essays treats of a great variety of subjects, but, in spite of this, is unified by the author's deep insight into and love of the history of science in its international character, linking science and philosophy.

The four main parts of the book are: (1) The Spread of Understanding, (2) Secret History, (3) East and West, and (4) Casting Bread upon the Face of the Waters. There are so many interesting questions touched upon that it seems impossible to refer, even briefly, to most of them. In his first essay Sarton tells how long it sometimes takes before an important discovery is generally accepted after overcoming the enormous inertia of vested traditions; illustrating this fact by the history of our numerals—the Arabic numerals, as they are often called, because the Moslems transmitted Greek, Hindu, and Iranian knowledge to the Christian West. 'The Hindus had made to mankind a gift of inestimable value', but more than a millenium had elapsed between the discovery and its general acceptance. Or another instance: The first systematic account of decimal fractions was published in 1585 by Simon Stevin,* but Sarton points out that Americans and Englishmen still use duodecimal fractions (feet, inches), vigesimal fractions (pounds and shillings), and sixteenths (to measure in pounds avoir-du-pois and ounces).

Treating of the interrelations of science and art Sarton reminds us of the man who was also one of the pioneers in the history of science, who was a hundred years ago the most famous man in the world: Alexander von Humboldt. Whoever knows his great work, the *Kosmos* (not Cosmos), will share Sarton's admiration for Humboldt. From the third essay, on *The History of Science*, we learn that 'the most natural hyphen between scientist and philosopher is the history of science', and that Sarton considers Auguste Comte its founder. (Comte applied to the French minister for the creation of a chair devoted to the subject *Histoire Générale des Sciences* as early as 1832). For Sarton the purpose of the history of science is 'to establish the genesis and the development of scientific facts and ideas, taking into account all intellectual exchanges and all influences brought into play by the very progress of civilization'. 'It follows from this definition that the only rational way to subdivide this history is not at all to cut it up according to countries or to sciences, but only according to time.' Of course it will be necessary to consider for each period of time the whole of its scientific and intellectual development. This is actually the way in which Sarton himself subdivided the history of science in his standard works. People with less erudition and less ability to co-ordinate

* Egyptians were already acquainted with a decimal system of numbers as early as the middle of the 4th millenium B.C., and Indians not much later.

facts and ideas in the broadest sense may perhaps do quite useful work in attempting to write the history of science as a history of single problems; which would, of course, necessarily remain what Sarton would call 'incomplete research'. But also for him 'the history of science is a history of ideas'.

In part II, the reader can admire how Sarton's biographical skill brings the past to life again, in his essays on Leonardo, Galois, Renan, and Spencer. We may wish to learn more details about Galois' mathematical achievements, especially those concerning the theory of groups, which is of such importance in today's science, even though we will be most interested in the description of this young genius' intellectual and emotional development. Most of us will be able to appreciate fully the essays on Leonardo, Renan and Spencer, and will agree with Sarton's idea that the international significance of the history of science has not been better grasped for the simple reason that very few historical studies have been inspired by a real international spirit. There are, however, for sure, others who do not see—or do not want to see—that 'the history of science—that is to say the history of human thought and civilization in its broadest form—is the indispensable basis of any philosophy'.

In *East and West* Sarton traces the rhythm between East and West, starting with the third millenium B.C. in Mesopotamia and Egypt. It is his aim 'to show the immense contributions which Eastern people made to our civilization', and as, by means of an unusual knowledge of languages, he has access to all the original sources, he can introduce us to the transition from oriental science to the early Greek and back again to the Eastern supremacy which ended about the eleventh century, after which time Muslim culture declined steadily. The reciprocal influences of East and West are presented in a fascinating and most convincing way.

Writing the history of science will involve the co-operation of many generations of scholars; therefore Sarton emphasizes the need of an Institute of the History of Science and Learning, combined with a very large library, whose members should not be simply 'annalists and historians, but humanists'. The striking features in these essays are Sarton's wide horizon, and at the same time his ability to see interrelations and concatenations which show the historical development of our culture in a new light.

ILSE ROSENTHAL-SCHNEIDER.

Mathematics

CARDINAL ALGEBRAS. By Alfred Tarski. (New York: Oxford University Press; London: Oxford University Press, Geoffrey Cumberlege, 1949. 326 pp. 5½" × 8½".) English price, £2. 10s.

The book presents the first coherent exposition of a new branch of mathematical research which in this form has been inaugurated by the author* and some of his collaborators during the last twenty-five years. Though not exactly a part of modern algebra, it is entirely based upon one of the fundamental principles of modern algebra, viz. *the concentration on the essential* (cf. the reviewer's article, This JOURNAL, *11*, 156, 1949). A Cardinal Algebra (C.A.) is the 'essential' of the system of all cardinal numbers with regard to the algebra usually developed in set theory in connexion with the notion of equivalence of sets. The notion of C.A. covers, however, various other algebraic systems with a single rule of composition of their elements. In the book, a C.A. is introduced as a system, A, of arbitrary elements closed with respect to a composition called addition, finite and infinite, satisfying certain postulates of associativity and commutativity, existence of a zero element, a 'refinement postulate' (i.e., if a, b, c_0, c_1, . . . in A and $a + b = \sum_{i<\infty} c_i$, then there are elements a_i and b_i in A such that $a = \sum_{i<\infty} a_i$, $b = \sum_{i<\infty} b_i$ and $c_i = a_i + b_i$) and an 'infinite chain axiom' (i.e., if $a_n = b_n + a_{n+1}$ then there is an unique c in A such that $a_n = c + \sum_{i<\infty} b_{n+i}$).

On this basis a partial order is introduced by definition which satisfies the usual monotony laws, and an extensive theory is developed in the first part of the book, pp. 3-66. In the second part of the book the author introduces the 'generalized' C.A.'s, mainly by dropping the closure postulate for the addition. The student of modern algebra will at this stage be reminded of the extension of the notion of abstract group into that of a groupoid. A third part (pp. 175-252) deals with applications of the abstract theory to such 'concrete' matters as semigroups, lattices, algebra of sets, to mention only a few. The rest of the book is taken by an appendix dealing with an application particular to the main subject.

There is no doubt that the work is of great interest to the specialist in abstract algebra and in set theory. The reviewer, however, feels that the author has set a very hard task for the reader who approaches the subject for the first time. The short references in the preface do not help to explain the details of the fundamental system of postulates and its variations derived early in the first part. An extensive introduction containing some of the material of the third part would have made the whole work more accessible. Then one should also be more inclined to forgive the author the extreme shortness of exposition. Many apparently not obvious proofs run as

* Well known by his work in mathematical logic and related topics in abstract algebra ('Boolean algebras') and set theory.

follows: 'by 9·11 with the help of 1·22, 1·43 and 2·2'—requiring an unusual degree of patience and concentration.

H. SCHWERDTFEGER.

Toxicology

THE CHEMISTRY OF INDUSTRIAL TOXICOLOGY. By H. B. Elkins. (New York: John Wiley, 1950. 406 pp., 24 text-figs., numerous tables. 5½" × 8½".) Price, $5.50.

This book, written by the Chief of the Division of Occupational Hygiene, Massachusetts Department of Labor and Industries, will prove of great value to all industrial chemists and engineers who are responsible for the manufacture or use of toxic substances. The emphasis is not on the nature of the physiological effects (although these are mentioned briefly), but on the chemical and physical properties, the methods for detection in small quantities, and on the seriousness or otherwise of the hazard.

After two introductory chapters on the nature of the toxic effects, the avenues of absorption, and the evaluation of the hazards, the various toxic substances are treated individually. This is the largest section of the book, and brief notes are included on the physical properties, the harmful effects and maximum allowable concentrations. All the common industrial poisons are discussed; the elements themselves, inorganic derivatives, and very many organic substances. The reviewer did not notice any serious omissions in the list, for over two hundred poisons are given, but some of the rarer organic substances are treated rather briefly. Possibly this is because so little is known about the hazards involved with such compounds.

Another interesting chapter includes a survey of the hazards likely to be encountered in various industrial processes. The section on preventive measures is rather brief, and the value of the book would have been enhanced by a fuller treatment of this important subject.

The final sections of the book are devoted to a discussion of the maximum allowable concentrations, and the methods of sampling and testing for toxic concentrations. Analytical procedures are given in great detail, even the method of calculation being set out. This might seem rather elementary, but in view of the importance of such tests it is necessary to eliminate all possible sources of error. The analytical procedures have all been selected by the author as the best available, and for further details the references given in each case may be consulted.

The complete bibliography containing 366 references is placed at the end of the book, which in the usual 'Wiley' standard is very well printed and bound.

G. M. BADGER.

Zoology

JOURNAL OF THE ZOOLOGICAL SOCIETY OF INDIA. Volume I, No. 1, January 1949. Published half-yearly by the Zoological Society of India, Calcutta.

PROCEEDINGS OF THE ZOOLOGICAL SOCIETY OF BENGAL. Volume II, No. 1. Published bi-annually by the Zoological Society of Bengal, Calcutta.

In the judgment of this reviewer, the production of new journals requires the strongest justification, for every such event adds to the expense which libraries all over the world must meet, if they can, and increases the multitude of publications which the scientist is supposed to watch for papers in his subject. Of the two journals whose names are given above, one is quite new, the other a year old. They both contain papers by Indian zoologists and even the prejudiced reviewer must recognize that the entry of a great people into the comity of independent nations is an occasion fully justifying the establishment of new avenues of publication for its scientists. Nevertheless, one cannot help being struck by the fact that both journals are published in Calcutta, and each by a zoological society, the one of India, the other of Bengal; and one cannot help wondering if two separate journals were really necessary.

The numbers of the two journals before me contain papers on a wide range of subjects, as will be sufficiently indicated by the following incomplete list: three papers by Loos on free-living and plant-parasitic nematodes; four morphological works on insects, a gecko, and protozoa; three in the field of fresh-water ecology; one on the ecology of a mound-building termite; one on the chromosomes of dragon-flies. Dr. Roonwal (*J. Zool. Soc. India*) has a presidential address 'On Zoological Standards and Progress'; in this he castigates his fellow Indian zoologists with some severity, charging them, among other things, with publishing too often and too readily, with displaying an insufficiently critical attitude, and with other offences not unknown elsewhere. How justified his strictures may be the non-Indian zoologist cannot say, but may observe that the recognition of deficiencies is the first step to their removal, and that they are not apparent at least in most of the papers here published. Zoologists all over the world will welcome the new journals, and will wish a brilliant future to all who write in them, and to Indian zoology.

P. D. F. MURRAY.

Zoological Nomenclature

The title of Richter's book on the International Rules of Zoological Nomenclature, as shown in the review published in This JOURNAL, *12*, 173, April 1950, should have read as follows:

EINFÜHRUNG IN DIE ZOOLOGISCHE NOMENKLATUR DURCH ERLÄUTERUNG DER INTERNATIONALEN REGELN. Second edition. By R. Richter.

The Australian Journal of Science

Vol. 13 21 October 1950 No. 2

Titanium Metal

J. P. BAXTER*

DURING the last five years there has been a big increase in the number of publications dealing with titanium metal. These publications reflect a growing interest and much research work on the preparation and study of the properties of this interesting element. It is pointed out that titanium is a very plentiful element, that it has a strength comparable with steel, a corrosion resistance similar to stainless steel and a density of 4·5. From this it is argued that titanium will be one of the important constructional materials of the future, provided that the problems of preparing the metal cheaply and of fabricating it can be solved.

The development of this interest in titanium has been a recent one. The element was first discovered in England in 1791 by a Cornwall parish priest named Gregor and it was re-discovered in 1797 by Klaproth in Hungary. Klaproth called the ore (rutile) in which he recognized this element a titanic ore, from which the name titanium was subsequently derived. In the succeeding years various people, including the great Berzelius, claimed to have isolated the metal, but it is clear from their results that what they produced was invariably an impure and highly contaminated substance having none of the properties of pure titanium. In 1926 when W. M. Thornton wrote the American Chemical Society's monograph on titanium he described it as a hard, brittle metal. In fact, about that time, in 1925, Van Arkel in Holland was preparing the pure ductile metal for the first time. This he did by decomposing the vapour of pure titanium tetraiodide on an incandescent filament. The metal he prepared was soft and silvery-white in appearance. This process was used by the Philips Company to prepare titanium metal on a small commercial scale and it was later worked in America by several organizations.

In 1940 W. J. Kroll published an account of the preparation of ductile titanium by the reduction of titanium tetrachloride with magnesium, followed by the use of a powder-metallurgical technique on the powder so obtained to give the massive metal. This process was taken up by the United States Bureau of Mines where it was developed on a substantial scale. Since then it has been used by various commercial concerns, notably the Du Pont Company in America. Research work on this and similar processes and on the associated metallurgical problems is proceeding today on a very large scale in the United States and to a lesser extent in Great Britain, Australia and other parts of the world.

While the physical properties of titanium metal are mainly responsible for the interest which it is arousing, a second and perhaps equally important reason is the plentiful nature of the ores of this element. Titanium is one of the more plentiful elements in the earth's crust. It has been estimated that it makes up 0·62 per cent. of the lithosphere. It is ninth in the order of abundance of the elements, being one-third as plentiful as magnesium and five times as plentiful as phosphorus and nine times as plentiful as sulphur. It is more than four times as plentiful as copper, zinc and lead.

Sources

While titanium occurs in many minerals, only two are of any real commercial importance. These two are rutile and ilmenite. Rutile is titanium dioxide, while ilmenite is a substance of variable composition which can be described as ferrous titanate with varying amounts of iron oxide, containing in some cases magnesium and calcium. It has the general formula $\text{M}.FeTiO_3,\text{N}.Fe_2O_3$ Titaniferous magnetites of very variable composition occur widely. Both rutile and ilmenite have been worked for many years as sources of titanium oxide required in

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ever-increasing amounts for the pigment industry and for the preparation of glazes, enamels and other ceramic wares. The table shows the production in various parts of the world of rutile and ilmenite for some typical years between 1936 and 1948.

Source	Ilmenite				Rutile		
	1939	1944	1946	1948	1936	1944	1946
India	237,835	100,794	185,023	—	185	1,646	258
United States	13,038	248,759	252,185	372,000	—	6,180	6,654
Canada	3,298	30,333	1,207	—	—	—	—
Australia	—	3,902	4,580	—	707	8,703	7,192
Malaya	11,086	—	—	—	—	—	—
Norway	54,158	62,965	51,744	—	163	84	62
Portugal	494	—	380	—	—	—	—
French Colonies	4,201	—	4,240	—	157	3,270	1,240
Brazil	10	4,921	—	—	481	1,539	—

The interesting thing about these figures is the rapid rise of the United States to be the world's major producer of ilmenite, with a corresponding decline in Indian production, and the relative importance of Australia as a producer of rutile.

Ilmenite is usually found either in the massive form or in sea-concentrated sands. The outstanding deposits of the latter type are in the State of Travancore in southern India, but other deposits occur in many parts of the world. American production comes from a number of places, such as sand deposits in Florida and mines in the States of Virginia and New York, from which very substantial production is obtained. The most notable deposits in North America are at Allard Lake in Eastern Quebec, where a very large massive ilmenite deposit exists. Figures of 125,000,000 tons have been given for the proved deposits in this area and the total reserves are probably much greater.

In the past, ilmenite has generally been shipped as such for chemical treatment with sulphuric acid, in most cases for the preparation of pigments. In this process the iron is subsequently thrown away as ferrous sulphate. In connexion with the deposits in Eastern Quebec, a new process has been developed in which the ilmenite is smelted in an electric furnace in the presence of alkaline slag-forming materials, resulting in the production of metallic iron and a fluid slag containing a high percentage of titanium oxide. From 65 per cent. to 70 per cent. of titanium oxide in the slag is expected. These slags should form a satisfactory raw material for the pigment industry. As in the process the iron is recovered as metal, an economically attractive result should be obtained. It has been stated that plant is being erected at Sorel on the southern bank of the St. Lawrence River which will initially produce 175,000 tons a year of iron and 230,000 tons a year of 70 per cent. titanium oxide slag. It would seem likely that this type of process may find favour in other parts of the world where ilmenite is produced and where electric power is cheap.

It is quite clear that the world's reserves of workable titanium minerals are adequate to support a large metal-producing industry and that no fears need be entertained that a satisfactory metal-producing process might be restricted in its development through shortage of raw material.

Up to the present, titanium metal has been prepared mainly by the two processes which have already been mentioned; that is, by the reduction of the chloride with magnesium, and by the decomposition of the iodide. The second of these processes is more commonly regarded as a means of preparing very pure metal starting with less pure material made by some other process. In addition to these two processes, titanium has been made by the reduction of the oxide with calcium metal. This has been worked in America, in England and in Germany. A purification process similar to the iodide method, only using the bromide, was operated in Germany during the war. These methods do not appear to be of any commercial importance at present.

Magnesium Process

The magnesium process has been extensively studied by the United States Bureau of Mines, who have operated it on a substantial scale. The first step in this process is the conversion of titanium oxide or ilmenite into titanium tetrachloride. This can be done by chlorination in the presence of carbon at a raised temperature, and this process has in fact been used for many years to make titanium tetrachloride for use as a smoke-producing compound and as a raw material for the pigment industry. The scale of operation has never been very large, and if titanium metal is to be made by this process in amounts comparable with steel or aluminium then much development work will be required on the chloride process to enable it to be operated cheaply and in large units. After preparing titanium tetrachloride, it is necessary to purify it carefully from silicon and from carbon compounds and from other metallic impurities such as vanadium. This is done by distillation and by treatment of the liquid with metallic copper.

After purifying the titanium tetrachloride, the next step is to react it with molten magnesium metal. So far this has usually been done as a batch process, but as the scale of operation expands, methods will no doubt be found of working it continuously. In the batch process a steel reactor is used which can be heated in an oil-fired or gas-fired furnace. The vessel is fitted with an inlet for titanium tetrachloride and with a drain at the lowest point from which molten magnesium chloride can be withdrawn. This drain is sealed by a water-cooled plug. The reactor is first cleaned and then a charge of pure ingot-magnesium is placed in it. It is then closed with a lid which is welded in position. The air in the vessel is pumped out and replaced by argon or helium. A small positive pressure of this gas is maintained throughout the process. The temperature of the furnace is then raised and the magnesium is melted. The titanium tetrachloride is now run in slowly until the reaction is complete. A slight excess of magnesium is used so that the titanium shall be free from the trichloride, which is said to render it spontaneously inflammable. The molten magnesium chloride is drained off during and at the end of the process, leaving a mass of titanium sponge in the reactor. This is cooled in an inert atmosphere. The titanium sponge contains magnesium chloride and free magnesium. This was originally removed in the Bureau of Mines work by pickling with dilute hydrochloric acid, after which the titanium powder was dried and de-gassed by heating in a high vacuum. This method caused some deterioration in the quality of the titanium and it is now usually replaced by a direct distillation of the magnesium and magnesium chloride by heating the sponge to about 1000°C at a very low pressure. In this way, titanium sponge is produced which analyses 99·7 to 99·8 per cent. titanium metal.

It will be clear that in this process the raw materials are titanium oxide and carb n and electric power; and that the magnesium and chlorine which are used are recovered in the form of anhydrous magnesium chloride, which could be fed to an electrolytic cell where the magnesium and the chlorine could be regenerated. Apart from make-up losses there would be no consumption of magnesium or chlorine. It is important to remember here that a substantial part of the cost of operating an electrolytic magnesium process is the preparation of the anhydrous magnesium chloride. In the titanium process this will be avoided.

The scaling-up of a process of this sort from small batch operation to a large continuous plant will clearly involve many engineering and chemical engineering problems. There would seem to be no reason today why these problems should not be solved and the production of titanium on a large industrial scale achieved.

Iodide Process

The iodide process has not yet been operated on a large scale and its future development depends upon the demand for metal appreciably purer than that made in the magnesium process and upon the solution of a number of problems which arise when an attempt is made to scale up the iodide process. In its present form the process is generally worked in a similar manner to the original apparatus of Van Arkel, except that his glass equipment has given way to iodine-resisting metal alloys and that the scale has been increased to produce rods of metal which may be up to an inch in diameter. In Van Arkel's apparatus an incandescent filament of titanium usually in the form of a hairpin hangs in a vertical tube, around the walls of which is packed, behind a molybdenum screen, crude granular titanium metal made by some

other process. The vessel is pumped out to a high vacuum and a small amount of titanium iodide is added, which vaporizes at the temperature used. The vessel is immersed in a cooling bath at a temperature of about 160° and the filament is raised to about 1400° by passing an electric current through it. The titanium iodide is decomposed on the filament surface, depositing the metal, and the iodine then combines with the crude titanium, forming more iodide. In this way the crude metal is used up and highly pure titanium is deposited on the filament, which steadily increases in thickness. As the process proceeds the current through the filament must be increased to maintain the temperature and the process ends when the available current supply can no longer keep the filament hot enough.

The metal deposited in this way is exceedingly pure and is very soft and ductile. It is the purest form of the metal which has been made. Operated in the form which has been described, the process is very inefficient in its usage of electrical energy, the greater part of which is dissipated as radiation from the filament to the cooling bath. It seems not unlikely that a careful study of the process and of the manner of carrying it out could greatly improve the efficiency and might lead to a possible commercial method of operation. The development and the scaling-up of such a process to a really large scale would present some very severe engineering problems, but it should not be beyond the resources of the modern chemical engineer.

There is no doubt that much work is being done on other ways of producing titanium and it seems likely that better methods will be developed before long. There are obvious possibilities in electrochemical methods involving the electrolysis of fused salt systems containing titanium chloride or fluoride. Direct smelting operations to yield titanium alloys which might then be purified are also worth serious consideration.

Fabrication

After developing a satisfactory process for producing titanium metal, there still remain many problems in connexion with its fabrication and use. Before titanium can be fabricated by the ordinary methods of rolling, forging and extruding, it is necessary to prepare it in the form of ingots. While this can be done, as has been shown by the Bureau of Mines, by pressing and sintering the powder, for cheap and large-scale operation some casting technique is almost essential. Titanium metal melts at 1725°C and the molten metal reduces most refractory oxides. It also dissolves carbon and combines with all known gases except the rare gases. No other metal of such a high melting point is fused and cast commercially on any substantial scale.

Two promising methods have been developed for the casting of titanium. In the first the material is melted in a graphite crucible in a high-frequency furnace. Melting is carried out in an atmosphere of argon or in a high vacuum, and the furnace is designed so that the melting time and the contact with the crucible are as short as possible. In this way ingots of up to 100 lb. weight have been produced, in which the carbon content was not unreasonably high. Although carbon dissolves in molten titanium, it appears to crystallize (when the metal is cooled) as small nodules of the carbide which do not greatly affect the physical properties of the metal. Titanium cast in graphite crucibles usually contains 0·7 to 1·0 per cent. of carbon.

An alternative method developed at the Battelle Institute in America and used subsequently in other places is to melt the titanium in a water-cooled copper crucible by means of an electric arc. Melting is carried out in an atmosphere of argon. The arc is struck between a tungsten-tipped electrode and the titanium metal. By feeding titanium powder slowly into such an apparatus it is possible to build up a homogeneous ingot, although only a small part of it is molten at any given time. The titanium does not wet the copper crucible and the ingot comes away cleanly at the end of the process. The only impurity is a very small amount of tungsten, which appears to have little effect on the properties of the metal. This process is normally used for comparably small ingots of a few pounds weight, but it could clearly be adapted for a continuous casting process in which large ingots could be produced.

After obtaining an ingot of ductile titanium, many of the normal methods of metal fabrication can be applied. Iodide titanium can be reduced at least 95 per cent. by cold rolling without any annealing process. Cast magnesium-process titanium is somewhat harder,

but reductions of from 40 per cent. to 50 per cent. are possible in the cold. When titanium is annealed, this is usually done at from 800°C to 850°C, and is best carried out in an inert gas or a high vacuum. If annealing is carried out in air, an oxide skin is formed which may be removed by pickling, but some deterioration in the quality of the metal is inevitable. At 600°C titanium is appreciably softer than when cold and the rate of oxidation in air is not excessive. Using this temperature, warm rolling can be carried out successfully with only small deterioration in the quality of the metal. At 900° to 1000°C, titanium is easily worked and can be rolled or forged. It oxidizes rapidly at this temperature and the oxide penetrates the body of the metal, causing a general loss of ductility. Where it is desired to practise hot rolling it is better that the metal should be sheathed with steel or some other protective substance and the rolling performed out of contact with air.

The mechanical properties of hot titanium are such that it should be easy to extrude, but the choice of a die material is difficult owing to the ease with which titanium sticks to other surfaces. The same trouble arises in drawing operations, in which some success can be achieved by plating the titanium with another metal such as copper or by giving it a thin skin of oxide to prevent it sticking to the die.

Titanium can be welded successfully using the resistance method, in an inert atmosphere. Good results have been obtained using a helium arc in a helium-filled dry box. It is probable that argon would be equally successful.

Properties

The mechanical properties of titanium depend a good deal upon its purity and previous history. Iodide titanium in the annealed condition has a tensile strength of about 48,000 lb. per square inch with an elongation of 40 per cent. in one inch. If the iodide metal is cold-worked the tensile strength rises to 97,000 lb. per square inch, while the elongation drops to 11 per cent. in one inch. The strength of magnesium-process metal varies a great deal owing to the variations in oxygen content, but a typical specimen which has been annealed will have a tensile of 80,000 lb. per square inch and an elongation of 25 per cent. in two inches. The same material with cold work may have a tensile of 125,000 lb. per square inch and an elongation of 12 per cent. in two inches.

A very great deal of work has been done on the alloys of titanium of the titanium-rich type. Some notable improvements in mechanical properties have been obtained, and references have been made to alloys with tensile strengths from 150,000 to 200,000 lb. per square inch with satisfactory ductility. The final word, however, has not yet been said about these compositions. There is no clear indication yet of an alloying constituent which confers a high degree of resistance to oxidation at high temperatures. This is one of the qualities most to be desired in a titanium alloy. In spite of the work which has been done, there remains much more to do in the alloy field, particularly as much of the early work was done with samples of titanium of doubtful purity and in many cases of unknown oxygen content. With the greater availability of supplies of really pure metal, the metallurgy of this element should continue to yield interesting results.

In the field of corrosion resistance, titanium has some outstanding properties. Its resistance to oxygen at high temperatures is not good; but, although it combines with oxygen, massive titanium when heated shows no tendency to catch fire, an oxide skin being produced which slowly penetrates into the metal. The resistance to corrosion by sea water is outstanding and makes the metal of great interest to the marine engineer. Satisfactory resistance to the following agents has been claimed: all strengths of cold nitric acid and hot nitric acid up to 65 per cent., hydrochloric acid up to 3 per cent., and chlorine solutions and gas below 80°C. Dilute caustic soda solutions either hot or cold are without effect upon the metal and it is reported to be satisfactory for the handling of 80 per cent. hydrogen peroxide. It is clearly a material of considerable interest to the chemical engineer, and if it becomes available at a satisfactory price and if the problems of fabrication are successfully overcome it should find a definite place in the construction of plant for the chemical industry.

Conclusion

From what has been said it will be clear that titanium has great possibilities but that substantial difficulties and large expenditure of money upon research and development lie

between us and the realization of these possibilities. It has good mechanical properties and its low density must make it of interest to all designers of equipment where strength and weight are important, notably in aircraft and in transportation equipment. Its excellent corrosion resistance when exposed to sea water makes it of interest for the construction of ships and of sea-going aircraft. Judging by the amount of effort which is being put into this development today, we shall see and hear a great deal more of the uses of titanium during the next few years.

Application of Isotopes in Scientific Research

G. B. Gresford

Since certain isotopes have become available from the Atomic Energy Commission of the U.S.A. and the Atomic Energy Research Establishment, England, their application in many different spheres of research has been made possible. The extent to which advantage is being taken of their availability in Australia was demonstrated by the success of a conference, sponsored by the Chemistry Department of the University of Melbourne and by the C.S.I.R.O., which was held in Melbourne from 14 to 17 August 1950, to discuss the Applications of Isotopes in Scientific Research. The conference, which did not cover medical research, was attended by about 175 delegates, of whom 45 came from interstate. As well as providing information for scientists wishing to begin work involving isotopes, it provided an opportunity for those already working with them to have formal and informal discussions with other scientists having related interests.

After a formal opening by Professor E. J. Hartung the earlier sessions of the conference were devoted to papers on the general aspects of the theory and use of isotopes. J. C. Bower, in a paper on Fundamentals of Nuclear Physics, outlined the current theories of atomic structure and described the use of the cyclotron and the atomic pile for the production of isotopes. E. A. Cornish dealt with Statistical Problems in the Utilization of Isotopes. Radioactive decay is a random process in which the numbers of particles emitted are distributed in the Poisson distribution. The distribution function, properties of the distribution, parametric estimation, tests of the agreement of counting data with the expectation, the variance of functions of counting rates and the asymptotic approach to normality were all discussed in relation to the distribution. The Techniques of Assay of Stable Isotopes were outlined by J. D. Morrison; the use of density determination, spectroscopic methods and the mass spectrometer all being described. T. H. Oddie discussed Techniques of Assay of Radioactive Isotopes. He described briefly the measuring apparatus available and concluded that Geiger counters and ionization chambers are preferable for the usual tracer applications. The limitations imposed by the size, form and position of the source were stressed, and the importance of sample preparation.

V. D. Hopper dealt with Applications of Nuclear Emulsions to Physical Problems, outlining recent improvements in emulsion preparation which have again brought this tool into prominence in studies of radioactivity.

The Limitations of the Tracer Method in Scientific Research formed the subject of another session. G. M. Harris dealt with the matter from the physical viewpoint, discussing three main aspects—difficulties of experimental technique, the 'isotope effect', and chemical changes in the surroundings initiated by disintegration products.

W. P. Rogers discussed the use of tracers in biological experiments, which is based on the fundamental generalization that all isotopes of a given element are indistinguishable, one from the other, to biological systems. This generalization is not entirely true, however, and in some instances the divergence from the ideal is sufficient to limit the use of isotopic tracers in biological experiments.

The importance of taking adequate health and safety precautions in handling radioactive materials cannot be stressed too strongly to those using isotopes. D. J. Stevens outlined the hazards involved, discussed the 'maximum permissible dose' and described methods of providing adequate protection in the laboratory and checking on radiation exposure received.

In other sessions a series of papers was given describing research projects involving the use of isotopes in progress in different laboratories in Australia. I. Lauder outlined experiments involving the use of the heavy oxygen isotope O^{18} in studying reactions in liquid sulphur dioxide and the interchanges of oxygen between water and inorganic oxy-anions. Experiments aimed at a separation of the naturally-occurring isotope of potassium, K^{40}, were described by G. A. Elliott. These involved a method of cation exchange using artificial zeolites and a method of counter-current ionic migration. Large changes of abundance ratio were easily obtained by the latter method using a mixture of sodium and potassium salts, but prolonged attempts to obtain a detectable separation of the K^{40} isotope yielded negative results. Exchange Reactions and Problems of Chemical Structure were discussed by B. O. West, who

had studied exchange reactions of metal complex compounds of Ni, Fe, Cu, V, Zn, Mg, Co in various solvents, mainly water, pyridine and methyl cellosolve, or in aqueous mixtures of these compounds.

The use of isotopes in studying problems of fundamental entomology, and of insect control, is receiving attention from many authors. A number of such experiments were discussed by M. F. Day. C. R. Millikan contributed a paper on studies of factors affecting the distribution of manganese in plants by the use of Mn^{54}. W. Boas described experiments undertaken by P. J. Fensham on the measurement of self diffusion of tin, using Sn^{113}. F. K. McTaggart and J. E. Newnham described experiments in which Hf^{181} and Zr^{95} had been used to follow the enrichment of hafnium in various reactions and fractionation processes designed to effect the separation of hafnium from zirconium. J. Daly outlined attempts to devise radiometric methods for the rapid assay of ores containing uranium and thorium. In general, trustworthy thorium determinations can readily be made by radiometric measurements alone, but accuracy in uranium assay requires constant check by other methods. A. M. Downes discussed the general problems involved in the synthesis of isotopic molecules, referring to some practical points in experimental procedure; while F. I. Andersen dealt with the particular case of synthesizing molecules containing deuterium.

It is hoped to publish, in the form of Proceedings, the papers presented to the conference. During the conference visits were organized to the C.S.I.R.O. Division of Industrial Chemistry; to the Bureau of Mineral Resources, Geology and Geophysics; to the Commonwealth X-Ray and Radium Laboratory; and to the Physics Department of the University of Melbourne.

Artificial Radioactivity

C. B. O. Mohr*

Artificial Radioactivity. By P. B. Moon. (Cambridge: University Press, 1949. 102 pp., 28 text-figs. 8½″ × 5½″.) English price, 12*s*. 6*d*. net.

This recent addition to the series of Cambridge Monographs in Physics is a most useful up-to-date outline of the main phenomena and techniques of artificial radioactivity, as met with in elements of atomic number below 80. In other words, it deals with artificially produced elements which emit β-particles (positive or negative) and γ-rays. The subjects of natural α-radioactivity, artificial disintegration, and fission, are therefore not included, these being covered in a companion volume in the series entitled *Excited States of Nuclei*, by S. Devons.

The author packs a good deal of useful and interesting information in concise but readable form into fairly short compass. He assumes only very elementary acquaintance with the fundamental processes of radioactive decay and the simpler properties and behaviour of nuclear particles, and proceeds to give the reader the most recent information available, together with references to representative original papers for those requiring further detail. No great detail is given about experimental techniques (though the adequate amount given is supplemented by general references to the literature) and no mathematical knowledge is required. Thus the essentially theoretical and complicated theories of β-decay and K capture are descriptively and briefly dealt with and discussed in the light of experimental data. Yet the broad theoretical basis of the whole subject is implicit throughout the book. The printing is all that one has come to expect from the Cambridge University Press.

After the Introductory Chapter, and one on Identification and Measurement of Radiations and Particles, come the main two chapters—on Radioactive Processes in which Z (atomic number) Changes by ± 1, and on Radioactive Processes in which Z Does Not Change. Change of Z by $\pm$ 1 corresponds to two main nuclear processes: (*a*) β-decay with the emission of an electron or positron—plus a neutrino—from the nucleus, a nuclear neutron being converted into a proton or vice-versa in the process; and (*b*) K capture, or dropping of a K electron into the nucleus and its combining with a proton there to form a neutron, surplus energy being emitted in the form of a neutrino. The theory of the processes (*a*) and (*b*) is similar, as might be expected from Dirac's theory, which regards the positron as absence of an electron from one of an infinity of filled states of negative energy. The emission of a positron in process (*a*) may thus be regarded as the capture by a nucleus of an electron in a negative energy state, and it is thus an analogous process to the capture of a K electron in process (*b*). The neutrino theory of β-emission accounts for the continuous distribution of energies of the emitted particles, the neutrino taking part of the decay energy. Comparison of the form of the theoretical and experimental energy distributions of the β-particles also indicates that the mass of the neutrino must be less than one three-hundredth of the mass of the electron. Furthermore, the most recent experiments on the measurement of the recoil of the nuclei in processes (*a*) and (*b*) provide the strongest evidence to date—the only direct experimental evidence—for the existence of the neutrino.

A radioactive process in which Z does not change, corresponds to the change of a nucleus from one state of energy to a lower one, the difference in energy being passed on either (i)

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to a γ-ray, or (ii) to an electron in the K shell or higher shell of the same atom. Process (i) is exactly similar to the emission of visible light from an atom. There is the further similarity that groups of widely different lifetimes of the higher states may occur, longer lifetimes corresponding to 'metastable' states from which the system drops by a 'forbidden' transition. In the radioactive process, half-lives may range from unobservably small times (allowed transitions, with emission of 'electric dipole radiation') to days or months (forbidden transitions, with emission of 'electric quadrupole' or 'octopole' radiation). Similarly in β-particle emission, groups of half-lives occur for different nuclei corresponding to allowed and forbidden transitions.

The most important basic knowledge gained about nuclei by the study of these processes is that pertaining to their energy level schemes. From the energies of the β-rays or γ-rays emitted in the two main types of radioactive process considered here, we deduce the spacing of the nuclear energy levels. From the nature of the radiation emitted, whether dipole, quadrupole, etc., we gain information about the quantum numbers of the levels. Due to the existence of isotopes, we now know of over four times as many β-emitting nuclei as there are different chemical elements, so the experimentalist in this field has a job for life! A great deal of detailed information on nuclear energy levels has been amassed in recent years, but it is interesting to note how little has been added to our general basic ideas and theories since Fermi put forward his neutrino theory of β-particle emission in 1934. We still await a new theory which will bring the same understanding of nuclear energy levels as the Bohr theory of the hydrogen atom brought to the understanding of atomic energy levels. Since the interaction between all nuclear particles is large, whereas that between electrons in an atom is small compared with the nuclear attraction for the electrons, the nuclear problem is of an altogether higher order of difficulty, and we may have to wait some time yet for such a theoretical development.

We therefore have the comforting thought that Moon's little book is not likely to 'date' at all quickly, even in these days of super-cyclotrons.

A Marine Station on the Great Barrier Reef

WHEN the last war ended, the late Professor E. J. Goddard began to develop plans for a marine station on Heron Island. After he died, the possibility of taking up the project came before the Great Barrier Reef Committee, which resolved to make the establishment of a marine biological station on the reef one of its major activities. It voted £500 from its funds, and appointed a sub-committee to implement the proposal. Sufficient progress has now been made for an interim report to be issued.

Objects and Scope

The purposes of the station will be:

- for research into reef biology and associated problems;
- for training young research workers in biological work;
- for research into economic problems of fisheries, tourist development, etc.

It will also be a centre from which geological, physiographical or botanical investigations may be undertaken.

It is not intended to establish an institution, but to provide a facility which may be used for training and research by workers from all over Australia and abroad. Whether there are enough marine biologists in Australia with the leisure or the specific occasion to occupy the station fully from its completion is uncertain; but there is no doubt about the interest that has been created abroad, and the Committee feels strongly that provision of the facility will lead to increasing activity here, and that it will be a valuable aid in building up the scientific manpower of this country.

Site

Heron Island offers many advantages: rich growth of coral and an abundant reef fauna; proximity of other reefs and cays; nearness to Brisbane; and an established settlement* which is interested in the project and from which stores, services, the use of large boats, and, if necessary, accommodation, might be hired. Disadvantages are the poor anchorage and the risk of hurricanes, both of which are inseparable from the use of a coral cay on the coast of Queensland.

Professor C. M. Yonge considers the site a good one; and if the venture is successful there is no reason why it should not be extended in the form of sub-stations further north.

Plans and Equipment

Professor R. P. Cummings has prepared draft plans of a building, which could be constructed of locally-made coral bricks. Experimental bricks have been tested and found satisfactory; their use will greatly reduce the costs of materials and transport. The building is elongate, with a central, nearly square section for tanks and aquaria, and a rectangular laboratory section at one end balanced by living quarters at the other. The laboratory section, as at present planned, includes two stores, a dark-room, three medium-sized laboratories and one large laboratory (28 feet by 21 feet). Either section may be extended or shortened,

* Owned by the Poulson estate.

as funds and needs may dictate. The local rainfall is only about 18 inches a year, so provision will be made for maximum storage of fresh water. Electricity and pumped salt water will probably be drawn in the first instance from the existing supplies of the settlement.

It is proposed to equip the station only with basic equipment of general utility in marine work. Workers would have to bring their own microscopes and other expensive or special equipment, but would be able to draw ordinary glassware and reagents from the store. One or two small boats fitted with outboard motors will be provided, and a man will be employed to act as general attendant, caretaker and boat-keeper for the station.

Recognition and Support

The proposals have been submitted in general terms to scientific organizations and individual biologists in Australia and abroad. They have been well received, and have been given official recognition by the following bodies: A.N.R.C., A.N.Z.A.A.S., C.S.I.R.O., the Pacific Science Association, the Royal Society, and the Royal Geographical Society. In some instances recognition has been accompanied by very tangible evidence of approval, of which the most notable has been the splendid gift by the Royal Society of £1000 sterling from its E. T. Browne fund.

Finance

A preliminary estimate, based on the sketch plans, was that the building would cost about £5000, and £500 has been allowed for basic equipment. These are the initial capital sums aimed at. The special fund created for the purpose now stands at:

	£	s.	d.
Great Barrier Reef Committee	500	0	0
Goddard Memorial Fund* ...	517	9	1
Royal Society (E. T. Browne Fund)	1250	0	0
Other donations	201	5	0
Total,	£2468	14	1

Approval has recently been received for gifts to the fund to be rebatable for taxation purposes, and the Committee is now seeking to augment it substantially from individual donations. It is hoped, too, that both the Commonwealth and Queensland Governments may become interested in the project.

The problem of maintenance is also receiving attention, but plans are not sufficiently mature to warrant a report at the present time.

Immediate Development

The immediate plans of the Committee are:

(1) To augment its special fund by all means in its power.

(2) To have final plans, specifications and estimates prepared so that construction may be commenced without delay.

(3) To develop its proposals for annual maintenance, which, it is estimated, will cost initially about £750 per annum.

The Committee hopes that its work will be sufficiently advanced for an opening ceremony, even of an unfinished building, to be held at the time of the A.N.Z.A.A.S. meeting in Brisbane next year.

* On the condition that an appropriate part of the station bears the name of the late Professor E. J. Goddard in his perpetual memory.

Australian National Committee of Crystallography

ALTHOUGH classical crystallography is an old and noble science, the application of X-ray techniques to crystal structure analysis within the last thirty-five years has focused attention upon the importance of this branch of scientific endeavour to such an extent that it may truly be said today that crystallography in general, and X-ray crystallography in particular, may be regarded as one of the major fields of scientific research and development. With the conclusion of World War II and the consequent relaxation of restraints on the publication and international dissemination of scientific information, there has been, as with most other sciences, a spate of articles and papers in the technical journals on matters of common interest to crystallographers. It was soon recognized that the time had come to promote the formation of a new member to the well established International Council of Scientific Unions,* viz., an International Union of Crystallography.

The 1947 Report of the Executive Committee of the I.C.S.U. records that 'the proposal to establish an International Union of Crystallography arose from an international meeting of crystallographers held in London in July 1946 under the chairmanship of Sir Lawrence Bragg and with the co-operation of the X-ray Analysis Group of the Institute of Physics. The possibility of adhering to the International Union of Pure and Applied Physics as a Commission within that Union was discussed at length, but for many reasons was considered less satisfactory than the formation of a separate Union of Crystallography'. Accordingly, proposals were submitted to the Executive Committee of the Council of Unions, and formal recognition of the new Union by the I.C.S.U. was granted on 7 April 1947. In the following year the Union held its First General Assembly and International Congress at Cambridge, U.S.A., at which the Statutes and By-laws were adopted and the first office bearers were elected. At the present time the latter include Professor

* This JOURNAL, *10*, 127 (1948).

Sir Lawrence Bragg (U.K.) as President, and Dr. R. C. Evans (U.K.) as General Secretary of the Union.

Full accounts of the principal business transacted at the First General Assembly have been given elsewhere,† but the following extract is of interest here, in setting out the objects of the Union:

(*a*) To promote international co-operation in crystallography;
(*b*) To promote international publication of crystallographic research and of crystallographic works;
(*c*) To facilitate standardization of methods and of units in crystallography;
(*d*) To form a focus for the relations of crystallography to other sciences.

In accordance with these objects and with the general practice of the other International Unions, the Union of Crystallography has established a number of commissions to co-ordinate and administer its functions. One important activity in connexion with object (*b*), above, has already proved extremely valuable, viz., the establishment of an international journal of crystallography. This journal, *Acta Crystallographica*, sponsored by the Union, is published with financial help from UNESCO and from British and American research associations, industrial firms, and other organizations. Publication began in 1948 and consists of six issues a year. The journal covers all aspects of crystallographic research and is therefore not only of direct interest to crystallographers, but also of general usefulness to workers in those fields where crystal structure and its relationship to specific properties of matter has a bearing on their own particular problems.

Countries may adhere to an International Scientific Union either through an existing scientific institution, or, if no appropriate body is in existence, by the formation of an independent national committee. In either case, however, a national committee is formed for this purpose. In Australia the adhering body is the Australian National Research Council, and when Australia joins an International Scientific Union the A.N.R.C. appoints an appropriate national committee. As far as crystallography is concerned, a rapid increase of interest in pure and applied crystallographic research has taken place in Australia within the last few years, and many university and government laboratories now have groups actively engaged on X-ray crystallography and/or allied subjects. The interest shown in this country in developments in these fields was well exemplified by the wide range of papers on X-ray crystallography which were presented as part of a 'Conference on X-rays in Industry', arranged by the Australian Branch of the Institute of Physics in November 1949.* In April last year the A.N.R.C. decided to adhere to the International Union of Crystallography, and accordingly appointed a National Committee of Crystallography. At the present time the Committee is composed of thirteen members drawn from various university and government laboratories throughout Australia, and represents a wide range of crystallographic interests. The main objects of the Committee are to promote and co-ordinate in this country the study of crystallography, particularly in relation to international requirements; and to keep crystallographers and other interested scientists here aware of international developments in crystallography, such as conferences, publications, agreements on standardization of apparatus and nomenclature, etc. If deemed advantageous, it will also appoint subcommittees to deal in Australia with specific aspects of crystallographic work, so that the views of Australia may be passed on to the appropriate Commissions of the International Union of Crystallography.

The Second General Assembly and International Congress of the International Union of Crystallography will be held in Stockholm next year and it is expected that one member of the Australian Committee will attend as a delegate to that Assembly.

The contributions of Australia to various phases of crystallographic research are increasing steadily, and it may be confidently expected that along with other nations she will play her part in international crystallography.

R.I.G.

† *Acta Cryst.*, *1*, 275; 340 (1948).

* A summarized account of the proceedings of this conference will appear shortly in the *British Journal of Applied Physics*.

The Edgeworth David Medal

The Edgeworth David Medal, 1949, has been awarded to T. B. Kiely, plant pathologist of the New South Wales Department of Agriculture, stationed at Gosford.

Studies have been undertaken during the past ten years by Mr. Kiely on the Black Spot disease of citrus in the central coastal district of New South Wales. This disease has been one of the principal barriers to economic production of Valencia oranges. It was formerly considered that the main source of infection of young susceptible Valencia orange fruits was provided by the water-borne pycnidiospores of *Phoma citricarpa* McAlp. that had developed in lesions on mature fruit hanging in the same or nearby Valencia trees. Control of the disease could not be demonstrated, however, when affected mature fruit was entirely eradicated prior to the setting of the new season's fruit. This anomaly indicated the possible existence of an alternative source, or sources, of inoculum of the pathogen.

Kiely was able to demonstrate the widespread occurrence, under central coast conditions, of inoculum of this nature. Pycnidia,

spermogonia and pycnidio-sclerotia have been described by him occurring over the surfaces of dead citrus leaves in most central coast orchards. An ascigerous stage also of the fungus has been described—*Guignardia citricarpa* n. sp., which is capable of producing wind-borne ascospores throughout the year. The importance of this type of inoculum has been demonstrated, and the ascospores are now accepted as being the main source of infection of the young fruit.

By means of suitable isolation techniques, latent infections of *Guignardia citricarpa* have been demonstrated in the rind of mature and immature Valencia orange fruits at all stages. The latent nature of this disease has also been confirmed by infection studies. In one fruit, for instance, it was demonstrated that mycelium of the causal fungus had remained in a latent condition for a period of 384 days.

The occurrence of latent infections in apparently normal leaves of all citrus varieties has also been shown. A pure culture technique has been developed whereby green leaves apparently free from lesions may be removed from the tree and as the leaves die the air-borne inoculum is produced over the leaf surface. Young trees in nurseries have been shown to be infected in this way and it is considered that, conditions being favourable, the disease could be introduced into other citrus areas if this fact were overlooked.

Alternate host plants have been shown to exist amongst our native flora and these harbour latent infections, too; many producing ascosporic inoculum in their dead leaves, and so contributing to the available inoculum. Considerable attention has been paid to the conditions governing the development of the ascocarps and so to the availability of inoculum. This has contributed greatly to knowledge of the epiphytology of the disease.

Morphological studies of the causal fungus have been carried out. The development of the ascocarp has been followed and the taxonomic position of *Guignardia citricarpa* determined from these studies.

Kiely has also undertaken an extensive study of methods of controlling the Black Spot disease.

Obituary

Cyril Tenison White

Cyril Tenison White died suddenly on 16 August 1950. He was born on 17 August 1890, and at the age of fifteen was appointed Pupil Assistant to his grandfather, the late F. M. Bailey, Colonial Botanist of Queensland. In the earlier years of his training he illustrated Bailey's *Comprehensive Catalogue of Queensland Plants* with almost 1,000 pen and ink sketches, and his extensive collections were the basis for a large number of the new records in that work. In 1917, when his uncle, J. F. Bailey, was appointed Director of the Adelaide Botanic Gardens, Mr. White became Acting Government Botanist of Queensland and in the following year Government Botanist, a position he held until his death. His first important assignment was a collecting trip in 1918 to Papua. In 1923, at the invitation of Professor C. S. Sargent of the Arnold Arboretum, Boston, U.S.A., he made extensive collections in New Caledonia. As this type of work was done in his official leave periods, he was unable to accept a further invitation from the Arboretum to collect in New Guinea. One of his former assistants, L. F. Brass, took up the work; Mr. White published the results in the *Journal* of the Arnold Arboretum. He did some extensive collecting in New Guinea and the Solomons in 1944 and 1945: the material is still being examined. In 1939 he spent a year at the Royal Botanic Gardens, Kew, as liaison officer for Australian herbaria and cleared up many doubtful points in Quenelsand botany.

His work in Queensland was many-sided. He described new species of plants, mostly in the *Proceedings of the Royal Society of Queensland*; published articles on weeds and poison plants in the *Queensland Agricultural Journal*; wrote two botanical textbooks; and lectured regularly before scientific societies and clubs. He gave organized courses on botanical subjects to Adult Education students, and to forestry students at the Queensland University. He was a President of the Royal Society of Queensland, Naturalists' Club, Queensland Orchid Society, Horticultural Society of Queensland and the Royal Geographical Society of Australasia (Queensland Branch). The University of Queensland conferred the honorary degree of Master of Science on Mr. White, and in 1946 he was awarded the Mueller Memorial Medal by the Australian and New Zealand Association for the Advancement of Science.

[Information supplied by the Council of the Royal Society of Queensland.]

News

'Impact'

The Natural Sciences Department of UNESCO has established a new periodical under the title *Impact* to cover the field of the impact of science on society. It is designed to collect information on the various aspects of the international and social implications of science, and to present it in the form of abstracts so that it is more readily available. The abstracts will be drawn from the media of the spoken word, from films, and from exhibitions.

The first issue (June 1950) reports addresses on 'Science and Society' by P. Brandt-Rehberg

(Professor of Zoophysiology, Copenhagen); 'Food for Twice as Many', by S. Tovborg Jensen (Professor of Chemistry, Danish Agricultural High School); 'Ten Million Scientists', by E. W. Sinnott (Retiring President, American Association for the Advancement of Science); and 'The Encouragement of Science', by J. R. Oppenheimer (Princeton Institute for Advanced Study). The issue commences with a statement on 'The Impact of Science on Society', which is followed by an annotated bibliography giving details of the main historically-important literature in English.

Subscription rate is to be six shillings, or one dollar; but this rate is halved for the year 1950, because the first two issues are supplied free on application. The UNESCO sales agents in Australia are H. A. Goddard Ltd., 255A George Street, Sydney. Communications to the Editor should be addressed to the Natural Sciences Department, UNESCO, 19 Avenue Kléber, Paris 16e, France.

Philippine Agricultural Engineering Journal

The Philippine Society of Agricultural Engineers has established a new publication under the title *Agricultural Engineering Journal*. It is issued quarterly from March 1950. The first two issues include articles on soil sterilization by electricity; alcohol-gasoline blends as substitute fuels; artificial drying of rough rice; industrialization of Philippine fibres; the mechanization of corn culture; and other subjects. The rate of subscription is $3.00 (U.S.A.) a year. Communications should be addressed to the Society at P.O. Box 3168, Manila.

Commonwealth Scholarship Scheme

Commencing in 1951, 3000 scholarships (divided among the States on a population basis) will be available to boys and girls beginning courses at universities and technical colleges, for first degrees and for certain diplomas, both full-time and part-time. Applicants must, in general, be matriculants and be under the age of twenty-one years at the beginning of their commencing year, and should have resided continuously in Australia with their parents for the previous three years.

Awards will be made on the results of approved examinations. Holders of scholarships will receive payment of tuition fees and certain other compulsory expenses, without regard to the income of their parents. In addition, living allowances up to a maximum of £130 a year for students living at home and £169 a year for those living away, will be paid to full-time students, scaled down according to a means test. Employment gaining 30*s*. a week during vacation and 10*s*. a week during term will be permitted with the approval of the Universities Commission. A medical examination is required of applicants.

The closing date for application for 1951 scholarships is 31 January 1951. Information is available from the Universities Commission.

Provision has also been made for special Commonwealth Scholarships to be awarded to full-time students in 1951 who were engaged in approved courses in 1950. Conditions of award are designed to provide that the student would have been eligible for a Scholarship under normal conditions if it had been available when he commenced his course. Applications for such awards were required by 30 September 1950.

T. K. Sidey Summer-Time Award

The T. K. Sidey Summer-Time Award, consisting of a bronze medal and a prize of £100 (N.Z.) is given for contributions to human knowledge by original scientific research in: the study of light visible and invisible and other solar radiations in relation to human welfare; the general study of electromagnetic radiations of every kind. It is primarily, but not necessarily, made to a New Zealand scientist or for work carried out in New Zealand, and may be awarded in respect of a thesis specially prepared or published works, or both.

Applications are required by 28 February 1951 and should be addressed to the Royal Society of New Zealand, Victoria University College, Wellington, whence further information may be obtained.

American University Scholarships

Australian citizens who have completed four years' work or its equivalent at an Australian university or technical college of university standing, and will be under the age of thirty-five years, may apply for scholarships or fellowships to enable them to proceed to post-graduate study in American universities. The necessary forms may be obtained from American consulates.

Scholarships in veterinary science, dentistry, medicine and allied fields are limited for the time being because these faculties are much overcrowded. Successful applicants may apply for a Fulbright travel grant from the U.S. Educational Foundation in Canberra. The scholarships are for the academic year beginning in September 1951, but applications should be completed as soon as possible in order that selections may be announced by June 1951.

National Standards Commission

A National Standards Commission has been established to give expert advice upon the Australian standards of measurement held at the National Standards Laboratory of the C.S.I.R.O. in Sydney. The members of the Commission are:

L. G. H. Huxley, Professor of Physics, Adelaide (Chairman);

G. H. Briggs, Chief, Division of Physics, C.S.I.R.O.;

N. A. Esserman, Chief, Division of Metrology, C.S.I.R.O.;

W. M. Holmes, formerly Superintendent of Weights and Measures, Victoria;

F. J. Lehany, Chief, Division of Electrotechnology, C.S.I.R.O.

C.S.I.R.O. Advisory Council

The following are appointments of new members to the Advisory Council and State Committees of the Commonwealth Scientific and Industrial Research Organization:

New South Wales: Professor J. P. Baxter, O.B.E.; Professor D. M. Myers.

South Australia: Professor J. G. Wood.

Victoria: D. T. Boyd; G. B. O'Malley.

Merbein Research Station

The Commonwealth Viticultural Research Station at Merbein was taken over by the C.S.I.R. in 1927; it had previously been conducted by the District Research Committee, which established it in 1919. From the time of its first establishment it has been in the charge of Mr. A. V. Lyon, who has now reached the retiring age.

The new officer-in-charge is to be Mr. Frank Penman, the Chief Irrigation Officer of the Victorian State Rivers and Water Supply Commission. Mr. Penman has had research experience in problems of soils and irrigation, particularly in relation to vine and citrus culture, and is the author of a number of publications.

Prevention of Deterioration Abstracts

The *Prevention of Deterioration Abstracts*, published by the National Research Council, 2101 Constitution Avenue, Washington 25, D.C., U.S.A., are offered for subscription on a yearly basis. Abstracts are classified under the headings: Biological agents; Electrical and electronic equipment; Fungicides and other toxic compounds; Lacquers, paints and varnishes; Leather; Lubricants; Metals; Miscellaneous; Optical instruments and photographic equipment; Packaging and storage; Plastics, resins, rubbers, and waxes; Textiles and cordage; and Wood and paper. One volume of approximately 2000 loose-leaf pages is published each year in monthly issues. Subject and author indexes are compiled annually to cover abstracts issued from July through June. The yearly rate of $50.00 includes binders and index tabs.

An *Advance List*, a monthly bibliography of all reports received in this field, is available for $10.00 a year.

Georgina Sweet Fellowships

The Georgina Sweet Fellowship in Economic Zoology is to be awarded to the candidate showing the most marked fitness for and desire to pursue research in some branch of zoology which will promote the economic interests of the people of Australia. The Elizabeth Mary Sweet Fellowship in Medicine is to be awarded to the candidate showing the most marked fitness for and desire to pursue research into functional diseases of children in Australia, especially metabolic derangements or deficiency diseases. The George Sweet Memorial Fellowship in Economic Geology is to be awarded to the candidate showing the most marked promise of fitness and ability for practical research in Geology, preferably of a kind based on the use of the non-metalliferous deposits of Australia.

Preference between candidates of equal merit will be given primarily, for the Georgina Sweet Fellowship, to a graduate in Science, Veterinary Science or Agricultural Science; for the Elizabeth Mary Sweet Fellowship, to a graduate in Medicine or Science and particularly to one whose course has included Physiology and Biochemistry; for the George Sweet Memorial Fellowship, to a graduate in Science, Agricultural Science or Engineering. Secondarily, preference is to be given to a graduate of the University of Melbourne. While the Fellowships may in general be held at any approved university either in Australia or abroad, it is considered that successful candidates who are not graduates of the University of Melbourne should hold their Fellowships at that university.

Each Fellowship has an annual value of £500, together with a certain allowance for equipment and material. Each Fellow is appointed for one year in the first instance, but may be reappointed for further periods. Particulars may be obtained from the Registrar of the University of Melbourne (Carlton, N.3, Victoria), with whom applications should be lodged not later than 15 December 1950.

Professor A. R. Todd

The N.S.W. Branch of the Royal Australian Chemical Institute arranged for Professor Alexander Robertus Todd, F.R.S., of the University of Cambridge, to visit Australia and give a series of lectures and conduct discussions in the capital cities during September and October. The Exposition Funds of the Branch were used to finance the visit.

Professor Tod received his academic training and experience in Glasgow and Frankfurt. He then worked at Oxford under Robinson as an 1851 Exhibition Senior Scholar. After teaching and research at Edinburgh, he joined the staff of the Lister Institute in London, and later the University of London, and the University of Manchester. He was elected F.R.S. in 1942 and has been Professor of Organic Chemistry at Cambridge since 1944. In 1949 he was awarded the Davy Medal for his work in organic chemistry and biochemistry, with special reference to vitamins and nucleotides.

Pacific Science Association

The Pacific Science Association has announced the appointment of the following members to form its standing committee for the Distribution of Terrestrial Faunas of the Inner Pacific: R. L. A. Catala (Noumea); I. McT.

Cowan (University of British Columbia); C. A. Gibson-Hill (Raffles Museum, Singapore); M. A. Lieftninck (Bogor, Java); Guillermo Mann (Santiago); Canuto G. Manuel (Manila); Ernst Mayer (American Museum of Natural History, New York); A. W. B. Powell (Auckland Institute and Museum); E. Le G. Troughton (Australian Museum, Sydney); Elwood C. Zimmerman (Bishop Museum, Honolulu). The Chairman of the Committee is E. G. Turbott, Auckland Institute and Museum, Box 27, Newmarket, Auckland, S.E.1, N.Z.

Secretaries of other committees have been appointed as follows:

- Mountain Structure in the Pacific Area—Dr. H. A. Brouwer, Geologisch Institut der Universiteit van Amsterdam, Amsterdam, Holland (Chairman).
- Pacific Conservation — Dr. F. Raymond Fosberg, Pacific Vegetation Project, Catholic University of America, Washington 17, D.C., U.S.A.
- Pacific Meteorology—R. H. Simpson, U.S. Weather Bureau, Box 3650, Honolulu, Hawaii.
- Anthropology and Social Sciences of the Pacific—Dr. Katherine Luomala, University of Hawaii, Honolulu.
- Oceanography of the Pacific—Dr. John P. Tully, Pacific Biological Station, Nanaimo, B.C., Canada.

Inter-Commonwealth Universities' Conference

At the Sixth Quinquennial Congress of Universities of the Commonwealth, which was held at Oxford in 1948, it was decided that each year a similar meeting of representative Heads of Universities or Senior Academic Officers from each part of the Commonwealth be held.

A section of the conference opened at Wairakei in New Zealand on 31 July, and sessions were held at Auckland, Dunedin, Christchurch and Wellington. The conference closed on 21 August.

The Universities of Australia were represented at this conference by Professor Sir D. G. Copland, Vice-Chancellor of the Australian National University, and Professor G. A. Currie, Vice-Chancellor of the University of Western Australia.

Delegates from other countries were: D. Emrys Evans (Wales), D. W. Logan (London), Sir Philip Morris (Bristol), C. E. Raven (Cambridge), Sir Raymond Priestley (Birmingham), F. Cyril James (McGill), Sidney Smith (Toronto), Professor J. McKinnell (Mathematics, Natal), Professor J. T. Irving (Physiology, Cape Town), A. L. Mudalier (Madras), S. Sinha (Patna), S. M. Hossain (Dacca), G. V. Allen (Malaya), and T. W. J. Taylor (University College of the West Indies).

Sir Douglas Copland, K.B.E., C.M.G.

Sir Douglas Copland, who was granted a knighthood in the King's Birthday Honours, came from New Zealand in 1924 as the foundation professor of the new Faculty of Commerce in Melbourne. He has from time to time served the governments of Australia in advice, planning and administration, though he continued to teach until the outbreak of war in 1939. At the time of appointment to his present position as Vice-Chancellor of the National University, he was the Australian Minister to China.

National University

Dr. R. v. d. R. Woolley, the Director of the Commonwealth Solar Observatory at Mount Stromlo, has been appointed as Honorary Professor of Astronomy in the Research School of Physical Sciences of the National University. Dr. Woolley was educated at Allhallows, England, and at the University of Cape Town. After taking the degrees of M.A. and Ph.D. at Cambridge, he worked at Pasadena from 1929 to 1931 and was Chief Assistant at the Royal Observatory, Greenwich, from 1933 to 1937. During the war he was Chief Executive Officer of the Army Inventions Directorate and a member of the Optical Munitions Panel. Dr. Woolley will Continue as Director at Mount Stromlo, where research may be undertaken by students of the University.

Medical Research Scholarships

Applications have been invited from physiologists, microbiologists (including chemical microbiology), experimental pathologists, pharmacologists, biochemists (including physical biochemistry) and chemists (in the medical aspects of chemistry) for scholarships in the John Curtin School of Medical Research. Scholars in other fields of research will be invited to apply for further scholarships to be advertised later.

The object is to enable scholars to receive training in research methods. Scholars are not required to undertake to serve the university in any capacity at the expiration of their scholarships and will not necessarily be appointed to positions on the university staff. It is understood, however, that scholars proceeding overseas under the terms of the scholarship should return to a post in Australia. Because of exchange restrictions, scholars will not be able to work in the United States except in exceptional circumstances.

The tenure of scholarships is for two years commencing in 1951. Applications for extension of tenure may be considered after eighteen months. Living allowance for married and unmarried scholars is respectively £A550 and £A450 in Australia, £600 and £450 in England, per annum. Increases up to £stg.150 may be allowed for special reasons, and there are certain allowances for fees and special courses.

University of Sydney

The Professorial Board has recommended that there should be constituted a Committee of

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

October, 1950.

EDITOR: STEPHEN J. COPLAND, c.o. Linnean Society of N.S.W., Science House, 157 Gloucester Street, Sydney.

Vol. 28 **No. 3**

ENTOMOLOGY.

(Continued.)

15352. **Thompson, G. B.** The Lice of Petrels. Part IV. The Genus *Episbates*. *Ann. Mag. Nat. Hist.*, (11) xiv (118), Oct. 1947 (June 1948), 661–671, tfs. 1–8.—*Episbates* Harrison, 1935. Genotype, *E. pederiformis* (Dufour, 1835). Host: *Diomedea exulans* Linn. (Wandering Albatross).

15353. **Thompson, G. B.** A List of the Type-Hosts of the Mallophaga and the Lice Described from Them. *Ann. Mag. Nat. Hist.*, (11) xiv (119), Nov. 1947 (July 1948), 737–767.

15354. **Thompson, G. B.** A List of the Type-Hosts of the Mallophaga and the Lice Described from Them. *Ann. Mag. Nat. Hist.*, (12) i (5), May 1948 (Dec. 1948), 335–368.

15355. **Tindale, N. B.** A New Race of *Tisiphone abeona* Donovan (Lepidoptera, Rhopalocera) from South Australia. *Rec. S. Aust. Mus.*, viii (4), Dec. 1947, 613–618, pl. xix.—*T. abeona antoni* subsp.n. S.A.: Lake Edward (holotype and allotype); V.: Dartmoor; Mackenzie Creek, Grampians.

15356. **Tindale, N. B.** New Satyridæ of the Genus *Oreixenica* from South Australia and New South Wales together with Notes on the Recent Climate of Southern Australia. *Rec. S. Aust., Mus.*, ix (2), May 1949, 143–156, pl. xii.—Fam. Satyridæ: *Oreixenica kershawi* race *kanunda* nov. Millicent distr., S.E. of S. Aust.; *O. kershawi* race *phryne* nov. Fed. Cap. Territory. " On the basis of the occurrence of this humid climate requiring insect, and other evidence, it is suggested that the climate of post-Pleistocene times in southern Australia has been slowly deteriorating from one of pluvial conditions. The 'Great Arid' hypothesis for this period, suggested by Crocker and discussed recently by Crocker and Wood, is thought to be untenable."

15357. **Verhoeff, K. W.** Zur Kenntnis der Cambaliden und über einige neue australische Formen derselben. *Zool. Anz.*, Leipzig, cxlv (1–4), 1944, 27–45, tfs. 1–19.

15358. **Wallace, C. R.** A New Poison Bait for Black Beetle. *Agric. Gaz. N.S.W.*, lix (8), Aug. 1948, 435.—*Heteronychus sanctæ-helenæ*. Insecticidal dust containing 1·3 per cent. of the gamma isomer of benzene hexachloride.

15359. **Wason, E. J., and Lloyd, N. C.** Insect Pests. DDT and Codling Moth Control. *Agric. Gaz. N.S.W.*, lix (10), Oct. 1948, 538–540, illustr.—DDT has proved to be the outstanding insecticide tested to date, but its continuous or excessive use is followed by increased populations of woolly aphids and tetranychid mites (red mite and red spider) to the point where they become serious pests.

15360. **Weddell, J. A.** Control the Banana Weevil Borer. *Q'land Agric. J.*, lxvii (3), Sept. 1948, 146–149.—*Cosmopolites sordidus* Chev. Biological control: *Plæsius javanus* Er.; *Chrysopila ferruginosa* Wied.; imported. Hydrophilid beetle, *Dactylosternum hydrophiloides* McLeay.

15361. **Wharton, R. H.** New Species of Simuliidæ (Diptera, Nematocera) from New South Wales. *Proc. Linn. Soc. N.S.W.*, lxxiii (5–6), 1949, 406–412, tfs. 1–21.—*Simulium melatum* sp.n. Lett River, Hartley, Blue Mts., N.S.W. *Austrosimulium crassipes* Tonnoir, descr. V.: Sassafras; N.S.W.: Mt. Victoria and Wentworth Falls.

15362. **Womersley, H.** The Genus Tragardhula Berlese 1912 (Acarina, Trombiculidæ). *Trans. R. Soc. S.A.*, lxxii (1), 1948, 83–90, Fig. 1A-G, 2A-J.

15363. **Woodhill, A. R.** Observations on the Comparative Survival of Various Stages of *Aedes* (*Stegomyia*) *scutellaris* Walker and *Aedes* (*Stegomyia*) *ægypti* Linnæus at Varying Temperatures and Humidities. *Proc. Linn. Soc. N.S.W.*, lxxiii (5–6), 1949, 413–418.—With a Statistical Note. By Dr. D. B. Duncan.

15364. **Zeck, E. H.** Insect Pests. The Pine Aphid (*Cinara thujafolia*). *Agric. Gaz. N.S.W.*, lix (8), Aug. 1948, 422 and 426.—Infests various spp. of cypress pines of the genera *Thuja*, *Callitris* and *Cupressus*.

BOTANY.

Hon. Abstractor : J. W. Vickery.

15365. **Althofer, G. W.** Further Records of *Melaleuca pubescens* in N.S.W. *Vict. Nat.*, lxvi (7), 1949, 138.

15366. **Blake, S. T.** The Specimen, the Species and the Botanist. *Aust. Journ. Science*, xi (4), 1949, 119–123.—A thoughtful discussion on the use of the name as a symbol of a population, and on the methods and their limitations which are available to study such populations. Common misconceptions of the meaning and usage of names are considered. Inadequacy of material for study is the greatest handicap to systematics. The need for adequate representative specimens is stressed.

15367. **Burbidge, Nancy T.** Foliar Anatomy and the Delimitation of the Genus *Triodia* R.Br. *Blumea*, Supplement III, 1946, 83–89.—The leaf anatomy of species of *Triodia*, *Plectrachne*, *Sieglingia*, *Tridens*, *Triplasis* and *Triraphis* is figured and considered in relation to generic concepts. The structures in *Triodia* and *Plectrachne* show striking similarities, and marked differences from those of the other genera.

15368. **Burges, A.** The Genus *Dawsonia*. *Proc. Linn. Soc. N.S.W.*, lxxiv (1–2), 1949, 83–96.—Species of the genus *Dawsonia* form a well-marked group of mosses, extending from Tasmania and New Zealand through Australia and New Guinea to Borneo, the Celebes and Philippines. The species are considered under two sections, the *Longifolia* and *Brevifolia*. A key to the species is provided, and each species is described and its distribution noted. Synonyms and herbarium names are referred to the appropriate species.

15369. **Chattaway, M. Margaret.** Note on the Vascular Tissue in the Rays of *Banksia*. *Jour. C.S.I.R.*, xxi (4), 1948, 275–278.—The rays of *Banksia* have been found to contain radially aligned vascular tissue, and the origin and development of these strands have been followed in *B. serrata*. The purpose of the strands in the plant's economy is discussed.

15370. **Clifford, H. T.** Notes on the Common Heath (*Epacris impressa*). *Vict. Nat.*, lxvi (8), 1949, 143–146.

15371. **Coleman, Edith.** Menace of the Mistletoe. *Vict. Nat.*, lxvi (2), 1949, 24–32.—Causes for the spread of Mistletoe since human settlement are examined, and the role played by various species of birds and animals in its control and dissemination is discussed.

15372. **Davis, Gwenda L.** Revision of the Genus *Brachycome* Cass. Part II. New Zealand Species. *Proc. Linn. Soc. N.S.W.*, lxxiv (1–2), 1949, 97–106.—Three species are found in New Zealand. These are described, and their synonymy and distribution given.

15373. **Davis, Gwenda L.** Revision of the Genus *Brachycome* Cass. Part III. Description of Three New Australian Species and Some New Locality Records. *Proc. Linn. Soc. N.S.W.*, lxxiv (3–4), 1949, 145–152.—*Brachycome stolonifera*, *B. obovata* and *B. petrophila* are described as new and figured. An amended key is given to the species of the superspecies *tenuiscapa*. Recent collections chiefly from Victoria are recorded which extend the known distribution of several other species.

15374. **Eardley, C. M.** The Simpson Desert Expedition, 1939—Scientific Reports No. 7—Botany. Part II. The Phytogeography of Some Important Sandridge Deserts Compared with that of the Simpson Desert. *Trans. Roy. Soc. S. Aust.*, lxxii (1), 1948, 1–29.—In order to assess the comparative aridity of the Simpson Desert in relation to other important sandridge deserts of the world, a study has been made of the vegetation of seven of them. It is considered that vegetation is the best climatic index available for such regions where quantitative meteorological data are generally few. The Simpson Desert is placed fifth in degree of aridity.

15375. **Elliott, C. G.** The Embryogeny of *Pherosphæra Hookeriana*. *Proc. Linn. Soc. N.S.W.*, lxxiii (3–4), 1948, 120–129.—In the proembryo there are six to ten prosuspensor cells and generally four to six embryo initials arranged in two tiers. Each embryo develops independently and produces embryonal tubes, by the growth of which the embryos are separated. The nature of the embryo initials indicates podocarpean affinities, especially with *Dacrydium*.

15376. **Galbraith, Jean.** *Hakea vittata*, " Black " and " White ". *Vict. Nat.*, lxvi (9), 1950, 179.

15377. **Garden, J., and Johnson, L. A. S.** Proposals for the Conservation of the Names of Three Australian Genera. *Australasian Herbarium News*, No. 5 (1949), 3–5.—Reasons are set out to justify the proposals of conservation of *Thryptomene* Endl. against *Gomphotis* Rafin., of *Correa* Andr. against *Correia* Vell., and of *Grevillea* R.Br. ex Salisb. corr. R.Br. against *Grevillia* R.Br.

15378. **Garnet, J. Ros.** Additions to the Recorded Flora of Lake Mountain. I. Vascular Plants. *Vict. Nat.*, lxvi (8), 1949, 157–159.

15379. **Gauba, E.** Rectifications in the Nomenclature of some *Kochia* Species in the " triptera " Group. *Vict. Nat.*, lxvi (1), 1949, 12–13.—*Kochia decipiens* Gauba is shown to be a later synonym of *K. pentatropis* Tate. Its history is discussed. The name *K. decaptera* F. Mueller is shown to be based on imperfect dried flowers of an *Abutilon* sp. The structure and shape of the fruiting perianth is regarded as of primary importance in distinguishing the species of the group.

15380. **Jessup, R. W.** A Vegetation and Pasture Survey of Counties Eyre, Burrar and Kimberley, South Australia. *Trans. Roy. Soc. S. Aust.*, lxxii (1), 1948, 33–68.—The greater portion of the area described is arid or semi-arid. Distribution of the vegetation is determined primarily by climate, soils being of lesser importance. Eleven plant associations have been recognized and mapped, and named after their dominant species. These range from savannah woodland, savannah, mallee

scrub, tree-shrub-steppe and desert scrub to shrubland. Species found in each association are listed, and the effects of overgrazing discussed.

15381. **Kukenthal, G.** Vorarberten zu einer Monographie der Rhynchossporoideæ x and xi. *Fedde Repert.*, l, 1941, 19–50 and 112–128.—A systematic study of species of *Lepidosperma* (Cyperaceæ), largely Australian. Nine new varieties are described, and four new combinations in varietal rank are provided.

15382. **Learmonth, Noel F.** Rediscovery of a Long-Lost Fern. *Vict. Nat.*, lxvi (7), 1949, 129–131.—An account of the habitat in which *Asplenium præmorsum* has been found in Victoria for the first time since its initial record, and of the associated ferns.

15383. **Martin, D.** *Eucalyptus* in the British Isles. With Some Notes on Records of Frost Resistance. *Australian Forestry*, xii (2), 1948, 63–74.—An account of the species found to be cultivated with greater or less success in various parts of the British Isles.

15384. **May, Valerie.** Studies on Australian Marine Algæ. V. Observations on and Geographical Records of Various Species, Particularly those of the *Gelidium* Complex. *Proc. Linn. Soc. N.S.W.*, lxxiv (3–4), 1949, 196–202.

15385. **Monachino, J.** A Revision of the Genus *Alstonia* (Apocynaceæ). *Pacific Science*, iii (2), 1949, 133–182.—A taxonomic study of the genus which includes several Australian species.

15386. **Mort, G. W.** Vegetation Survey of the Marine Sand Drifts of New South Wales. Some Remarks on Useful Stabilizing Species. *Jour. Soil Conserv. Service of N.S.W.*, v (2), 1949, 84–91.—The distribution of vegetation on the coastal sand drifts of N.S.W. is discussed with special reference to the problems of sand-binding and dune-fixation. The most useful species are listed according to their growth habit, position of utility on the dunes, and locality distribution.

15387. **Moseley, M. F.** Comparative Anatomy and Phylogeny of the Casuarinaceæ. *Bot. Gaz.*, cx (2), 1948, 231–280.—An extensive study is made of the wood anatomy of 29 species of *Casuarina* based on specimens mostly located in various American and European collections, with a view to contributing towards a better understanding of the evolutionary states of the Casuarinaceæ, to presenting a thorough anatomical description of the family, and to tabulating the outstanding characteristics of the species examined. Evidence obtained from both the anatomy and the floral morphology indicates that the family is a specialized and not a primitive group possibly derived from Hamamelidaceæ-like ancestors. Further evidence is offered in discussions on gametophytic aberrations, nodal anatomy, cytology, palæobotany, pollen morphology and ecology.

15388. **Muir, E. T.** Notes on Marine Algæ at Portland, Vic. *Vic. Nat.*, lxvi (9), 1950, 176–177.

15389. **Nicholls, W. H.** *Pterostylis furcata*, an Elusive Orchid. *Vict. Nat.*, lxv (11), 1949, 255–258.—Note on a collection of *P. furcata* Lindl. from National Park, north-west of Hobart, Tasmania, and on the known distribution of the species in Australia. A description and figure are given.

15390. **Nicholls, W. H.** Additions to the Orchidaceæ of Western Australia. III. A New Species of the Genus *Caladenia* R.Br., also Three New Varieties and Sundry Notes on Other Species. *Vict. Nat.*, lxv (12), 1949, 267–270.—*Caladenia radiata*, *C. dilatata* var. *falcata*, *Prosophyllum australe* var. *Sargentii*, and *P. elatum* var. *Muelleri* are described.

15391. **Nicholls, W. H.** Additions to the Orchidaceæ of Western Australia. IV. *Vict. Nat.*, lxvi (3), 1949, 53–56.—Four new varieties of *Thelymitra spiralis* Lindl. are described and figured, viz. var. *Scouleri*, var. *pallida*, var. *punctata* and var. *pulchella*.

15392. **Nicholls, W. H.** The Genus *Microtis* (Orchidaceæ) in Victoria. *Vict. Nat.*, lxvi (5), 1949, 91–95.—Three new species of *Microtis* are described, viz. *M. bipulvinaris*, *M. Holmesii* and *M. biloba*. For comparison, brief descriptions of the other five species found in Victoria are also given.

15393. **Rupp, H. M. R.** The Orchid Flora of the Central Western Slopes of New South Wales. *Proc. Linn. Soc. N.S.W.*, lxxiii (3–4), 1948, 130–136.—Eighty-three species are recorded, based on earlier lists and more recent additions. Three species and one variety of *Diuris* are described as new, viz. *D. Althoferi*, *D. cucullata*, *D. cuneilabris* and *D. cuneilabris* var. *heliotropica*.

15394. **Rupp, H. M. R.** Robert Brown's *Genoplesium Baueri* (Orchidaceæ). *Vict. Nat.*, lxvi (4), 1949, 75–79.—Abundant material recently discovered has enabled a reconsideration of *G. Baueri* R.Br. This was placed in *Prasophyllum* by later authors and synonymized with *P. rufum* R.Br., while *P. Deaneanum* Fitzg. was described for a similar species. *P. Deaneanum* is now shown to be the same as *Genoplesium Baueri*, which, however, is quite distinct from *P. rufum*. The author considers that the genus *Genoplesium* should be retained as distinct from *Prasophyllum*. This further necessitates renaming the Section *Genoplesium* of the genus *Prasophyllum*, and the Section *Micranthum* is proposed for it.

15395. **Sims, H. J.** Plant Regeneration on Stabilized Sandhills in the Mallee. *Vict. Nat.*, lxvi (2), 1949, 37–39.—In parts of the Mallee, sandhills denuded of vegetation have become wind eroded. To effect stabilization, rye is planted to give a quick ground cover. This enables other species to colonize the area, and a list of plants observed within three years of the planting is given.

15396. **Specht, R. L., and Perry, R. A.** Plant Ecology of Part of the Mount Lofty Ranges. (I.) *Trans. Roy. Soc. S. Aust.*, lxxii (1), 1948, 91–132.—The climate, soils and vegetation of a portion of the Mount Lofty Ranges in South Australia have been studied and attempts made to correlate the distribution of the dominant trees and associations with the environment. Mechanical and chemical analyses have been made of soil samples typical of each soil group in the area, and suggestions given as to the genesis of each. The environmental range of the dominant species is discussed with reference to their environment in certain other parts of South Australia.

15397. **Turrill, W. B.** *Atherosperma moschatum. Bot. Mag.*, clvx (4), 1948, t. 43.—This species from south-eastern Australia is illustrated and described.

15398. **Turrill, W. B.** *Tetratheca ciliata. Bot. Mag.*, clxvi (2), 1949, t. 62.—This species from southern Australia is illustrated and described.

15399. **Wakefield, N. A.** New Combinations in Some Australian Ferns. *Vict. Nat.*, lxvi (3), 1949, 59.—The following new combinations are published: *Mecodium Whitei, Crepidopteris Wildii, Crepidopteris australiensis, Crepidomanes Majoræ, Craspedophyllum Cheesemanii, Cyathea Woollsiana.*

15400. **Wakefield, N. A., and Willis, J. H.** Victorian Fern and Clubmoss Records. II. *Vict. Nat.*, lxv (12), 1949, 279–281.—Collections of the following are recorded: *Botrychium lunaria, Sticherus flabellatus, Macroglena caudata, Notholæna vellea, Asplenium obtusatum, Cystopteris fragilis, Cyclophorus rupestris, Lycopodium carolinianum.*

15401. **Webb, L. J.** Guide to the Medicinal and Poisonous Plants of Queensland. *C.S.I.R. Bull.* 232, 1948, pp. 1–202, Melbourne.—A valuable compilation of the known or suspected poisonous properties of plants in Queensland, arranged in their botanical families, the families being listed in alphabetical order.

15402. **White, C. T.** Three Species of *Endiandra* (Family Lauraceæ) from Eastern Australia. *Proc. Roy. Soc. Qld.*, lix (6), 1948, 151–152.—*Endiandra introssa* is described as new from N.S.W. A new name, *E. microneura*, is provided for *E. reticulata* C. T. White, which is preoccupied. The synonymy is given of *E. virens.*

15403. **White, C. T.** *Melaleuca pubescens* in Queensland. *Vict. Nat.*, lxvi (2), 1949, 39.

15404. **Willis, J. H.** Botanical Pioneers in Victoria. I. *Vict. Nat.*, lxvi (5), 1949, 83–89.—Short biographical notes on Robert Brown, Allan Cunningham, Ronald Gunn, Thomas Mitchell, James Backhouse, Ferdinand von Mueller, A. J. Ewart and some of their associates.

15405. **Willis, J. H.** Botanical Pioneers in Victoria. II. Specialist Pioneers. *Vict. Nat.*, lxvi (6), 1949, 103–109.—Short biographical notes on some 20 botanists and collectors who have contributed substantially to knowledge of particular plant groups of the Victorian flora.

15406. **Willis, J. H.** Botanical Pioneers in Victoria. III. *Vict. Nat.*, lxvi (7), 1949, 123–128.—An account is given of early collectors in particular localities in Victoria, viz. the Lower Glenelg-Portland area, the Grampians, the Wimmera and Little Desert, the far North-West, the Bendigo Whipstick Mallee, the Melbourne region, the Alps, and the jungles of east Gippsland.

15407. **Womersley, H. B. S.** The Marine Algæ of Kangaroo Island. I. A General Account of the Algal Ecology. *Trans. Roy. Soc. S. Aust.*, lxxi (2), 1947, 228–252.—A general account is given of the environments suitable for algal development which are found on the coast of Kangaroo Is., considered in relation to wave action, tides, currents, temperature, salinity and aeration, light and substrata. The alga present are considered under the headings: A. The Rocky Coast Formation, and B. The Sand and Sandy-Mud Formation.

15408. **Womersley, H. B. S.** The Marine Algæ of Kangaroo Island. II. The Pennington Bay Region. *Trans. Roy. Soc. S. Aust.*, lxxii (1), 1948, 143–166.—The algal associations of the wave-cut rock platforms of the Pennington Bay region are described, and classed into supralittoral, littoral and sublittoral fringe associations. The deeper sublittoral flora is listed. On the flat surface of the reefs occur *Cystophora* associations and the *Hormosira* association. Other important associations are characterized by *Rivularia, Ectocarpus, Pylaiella, Enteromorpha* and *Cystophyllum.*

15409. **Womersley, H. B. S., and Ophel, I. L.** *Protochara*, a New Genus of Characeæ from Western Australia. *Trans. Roy. Soc. S. Aust.*, lxxi (2), 1947, 311–317.—*Protochara australis* is described and figured, and the combination *P. inflata*, based on *Nitellopsis inflata* Filarski and Allen. Their affinities are discussed.

GEOLOGY.

Hon. Abstractor: R. O. Chalmers.

15410. **Brewer, Roy.** Mineralogical Examination of Soils Developed on the Prospect Hill Intrusion, N.S.W. *Proc. Roy. Soc. N.S.W.*, lxxxii (4), 1948, 272–285.—Mineralogical analyses of the heavy concentrates of the surface and subsoils at two feet were made. The bearing of these on the determination of the position of soil boundaries and the recent history of weathering, amongst other things, is discussed.

15411. **Bryan, W. H. H.** C. Richards Memorial Address. *Proc. Roy. Soc. Qld.*, lix (2), 1947, 141–150.

15412. **Connah, T. H.** Vermiculite, Emu Creek, Blackbutt. *Qld. Govt. Min. J.*, li, March, 1950, 168.—An eleven-inch of vein of vermiculite, the first occurrence in Queensland, is recorded.

15413. **Connolly, H. J. C.** Geology in Explora tion: Mount Lyell Example. *Proc. Austr. Inst. Min. and Met.*, Nos. 146–147, 1947, 1–22.

15414. **Edwards, A. B.** Coal Types in the Yallourn and Latrobe Brown Coal Seams. *Proc. Austr. Inst. Min. and Met.*, Nos. 146–147, 1947, 23–69.—These seams consist in the main of alternating bands of varying thickness of two types of coal—lignitic and earthy. The properties of these types are dealt with. The origin of these types is thought to be related to variations in the water conditions of the coal swamp.

15415. **Ellwood, Dorothy.** Note on a Method of Microscopic Examination of Victorian Brown Coals. *Proc. Austr. Inst. Min. and Met.*, Nos. 146–147, 1947, 71–74.—Details of preparation of samples and cutting the sections are given.

15416. **Fairbridge, R. W.** Gravitational Tectonics at Shorncliffe, S.E. Queensland. *Proc. Roy. Soc. Qld.*, lix (2), 1947, 179–201.—A striking low-angle thrust plane and numerous small but intensely folded structures in a cliff section in sandstones and shales of Ipswich age are now described as having been caused by gravity sliding. The tectonics are of two generations.

15417. **Fairbridge, R. W.** Geology of the Country around Waddamana, Central Tasmania. *Proc. Roy. Soc. Tas.*, 1948, 111–149.—One or two massive dolerite sills intrude flat-lying Permo-Trias sediments locally covered by Tertiary basalt flows. Block faulting took place during the dolerite intrusion.

15418. **Fenner, Charles.** Sandtube Fulgurites and their Bearing on the Tektite Problem. *Rec. S. Aust. Mus.*, ix (2), 1949, 127–142.

15419. **Gill, E. D.** The Physiography and Palæogeography of the River Yarra, Victoria. *Mem. Nat. Mus. Vict.*, No. 16, 1949, 21–49.

15420. **Gradwell, R.** The Petrology of the Eruptive Rocks of the Yarraman District. *Uni. Qld. Dept. Geol.*, iii (8), 1949, 1–39.—The relationship of eruptive rocks which occupy the greater part of the area is discussed. Tertiary basalts and porphyries, and tonalite, granodiorite, rhyolite and andesite are described. The geological age of these four latter types is uncertain.

15421. **Guppy, D. J., and Matheson, R. S.** Wolf Creek Meteorite Crater, Western Australia. *J. Geol.*, lviii (1), 1950, 30–36.—This is the second largest meteorite crater on the earth's surface and is of Pleistocene to Recent age. Nickel estimations carried out on oxidized meteoritic material are given.

15422. **Hanlon, F. N.** Geology of the North-Western Coalfield, N.S.W. Part IV. Geology of the Gunnedah-Curlewis District. Part V. Geology of the Breeza District. Part VI. Geology of the South-Western Part of County Nandewar. *Proc. Roy. Soc. N.S.W.*, lxxxii (3), 1948, 241–261.—In the Gunnedah-Curlewis district and in County Nandewar Lower Marine lavas and Lower Coal Measures are described. In the former area there occur also the Upper Marine Series and the Upper Coal Measures. In the Breeza district only the upper part of the Permian sequence outcrops. Tertiary igneous rocks are present in all three areas. In the first two the Permian is overlain by Triassic and in the third area Kuttung rocks have been overthrust from the east, and the Triassic is missing.

15423. **Hanlon, F. N.** Geology of the North-Western Coalfield, N.S.W. Part VII. Geology of the Boggabri District. *Proc. Roy. Soc. N.S.W.*, lxxxii (4), 1948, 297–301.—Upper Coal Measure sediments have been deposited on the eroded surface of the Boggabri volcanic series (Lower Marine). Triassic and Jurassic sediments also are present.

15424. **Hanlon, F. N.** Geology of the North-Western Coalfield, N.S.W. Part VIII. Geology of the Narrabri District. *Proc. Roy. Soc. N.S.W.*, lxxxii (4), 1948, 302.—Carboniferous beds are succeeded by Lower Coal Measures and Upper Marine Beds. Triassic sediments and the well known Tertiary alkaline rocks that comprise the Nandewar Ranges are also present in the area.

15425. **Harris, W. J., and Thomas, D. E.** Geology of the Meredith Area. *Min. Geol. J. Dept. Mines Vict.*, iii (5), 1949, 43–51.—Physiography, general geology, structure and economic geology are dealt with.

15426. **Hayton, J. D.** Pink Beryl from Western Australia. *Rept. Dept. Mines, W. Aust.*, 1947, 151–152.—Analyses of three samples from Londonderry, Wodgina and Poona are given, the pink colour being ascribed to the rather high Li_2O content in each case.

15427. **Hills, E. S.** Shore Platforms. *Geol. Mag.*, lxxxvi (3), 1949, 137–152.—The use of the term "normal" and "abnormal" in relation to shore-platforms has led to confusion and should be discontinued. Processes operative in the formation of shore-platforms are analysed from Victorian examples. The effects of water-layer weathering, growth of marine organisms, breakers, and waves of translation on sheltered and open coasts and on various rocks (including a special study of platforms in æolianites) are discussed.

15428. **de Jersey, N. J.** The Chemical and Physical Properties and Classification of some Queensland Coals. *Uni. Qld. Pap. Dept. Geol.*, iii (n.s.) (7), 1949, 1–62.—Data are provided for a rank and type classification of Queensland coals and to demonstrate the relation of rank and type to the geology of the coalfields and to some of the chemical and physical properties of the coals.

15429. **Jutson, J. T.** The Shore Platforms of Lorne, Victoria. *Proc. Roy. Soc. Vict.*, lxi, 1949, 3–59.—Horizontal platforms cut out of dipping, jointed Jurassic sediments are described. There are two series, both having been formed with sea level as at present.

15430. **Jutson, J. T.** The Shore Platforms of Point Lonsdale, Victoria. *Proc. Roy. Soc. Vict.*, lxi, 1949, 105–111.—These are horizontal platforms composed of dipping dune limestone.

15431. **Langford-Smith, T.** The Geomorphology of County Victoria, South Australia. *Trans. Roy. Soc. S. Aust.*, lxxii (2), 1949, 259–274.—Physiographic zones are defined. Tectonic movements that have occurred since the Tertiary are correlated. The drainage systems are discussed with special reference to stream capture.

15423. **Malmquist, D.** Structure of the Muonionalusta Iron Meteorite and a Method of Determining the Orientation of Lamellæ of Octahedrites. *Bull. Geol. Inst. Uni. Upsala*, xxxii, 1946–1948, 277–328.—This method is applied to the Narraburra siderite, which is shown to be a true octahedrite.

15433. **Mawson, D.** The Late Precambrian Ice-Age and Glacial Record of the Bibliando Dome. Clarke Memorial Lecture. *Proc. Roy. Soc. N.S.W.*, lxxxii, 1948, 150–174.—The Precambrian sedimentary record of the central region of the late Precambrian to Middle Cambrian geosynclinal basin of South Australia as deduced mainly from

measurements made across the Bibliando Dome is shown to be some 50,000 feet. Details of the glacigene section of this sedimentary record are given and the nature of the glaciation discussed, and its effect on Precambrian life.

15434. **Mawson, D.** Sturtian Tillite of Mount Jacob and Mount Warren Hastings, North Flinders Ranges. *Trans. Roy. Soc. S. Aust.*, lxxii (2), 1949, 244–251.—A cross section of glacigene beds in both the Mount Jacob and Mount Warren Hastings areas. This latter belt is a repetition by faulting of the former.

15435. **Mawson, D., and Segnit, E. R.** Purple Slates of the Adelaide System. *Trans. Roy. Soc. S. Aust.*, lxxii, 1949, 276–280.—Chemical and field evidence indicates a terrestrial loessial origin for the chocolate shale belts of the Adelaide system.

15436. **Osborne, G. D.** The Stratigraphy of the Lower Marine Series of the Permian System in the Hunter River Valley, New South Wales. *Proc. Linn. Soc. N.S.W.*, lxxiv (5–6), 1949, 203–223.—The maximum thickness of the four stages, Farley, Rutherford, Allandale and Lochinvar, are given.

15437. **Osborne, G. D.** Note on the Occurrence of Tridymite in Metamorphosed Sandstone at Bundeena and West Pymble, Sydney District, New South Wales. *Proc. Roy. Soc. N.S.W.*, lxxxii (4), 1948, 309–311.

15438. **Osborne, G. D., and Andrews, P. B.** Structural Data for the Northern End of the Stroud-Gloucester Trough. *Proc. Roy. Soc. N.S.W.*, lxxxii (3), 1948, 202–210.—Preliminary investigation into various structural entities that are evaluated as criteria useful in diagnosing the evolutionary characteristics achieved by the Late Palæozoic orogenic episodes.

15439. **Osborne, G. D., Jopling, A. V., and Lancaster, H. E.** The Stratigraphy and General Form of the Timor Anticline, N.S.W. *Proc. Roy. Soc. N.S.W.*, lxxxii (4), 1948, 312–318.—Structure and stratigraphy of the Isis River district, N.S.W., is given. Zone fossils are listed for the Timor limestone.

15440. **Reeves, Frank, and Chalmers, R. O.** The Wolf Creek Crater. *Aust. J. Sci.*, xi (5), 1949, 154–156.—The crater is described and nickel content of oxidized material is given.

15441. **Samson, H. R., and Wadsley, A. D.** A Manganese Oxide Mineral from Buchan, Victoria. *Am. Min.*, xxxiii (11–12), 1948, 695–702.—A manganese mineral occurring as dense nodules intimately associated with hematite is found in eastern Victoria. The mineral is of the psilomelane type and possesses a colloform texture. X-ray powder patterns and chemical analysis indicate a mineral species corresponding closely to an oxide prepared in the laboratory and previously named manganous manganite.

15442. **Singleton, O. P.** The Geology and Petrology of the Tooborac District, Victoria. *Proc. Roy. Soc. Vict.*, lxi, 1949, 75–104.—Granitic rocks of epi-Devonian age intrude Cambrian, Ordovician and Silurian sediments. Metamorphic effects are described.

15443. **Sokoloff, V. P.** Geochemical Reconnaissance in the Wallaroo Mining District, South Australia. *Min. Rev. Dept. Min. S. Aust.*, No. 88, 1948, 32–71.—Correlation between known ore bodies and geochemical anomalies has been made. Details of sampling and chemical testing are given.

15444. **Stevens, N. C.** The Geology of the Canowindra District, N.S.W. Part I. The Stratigraphy and Structure of the Cargo-Toogong District. *Proc. Roy. Soc. N.S.W.*, lxxxii (4), 1948, 319–337.—Silurian, Upper Devonian and Upper Carboniferous sediments are dealt with.

15445. **Thomas, D. E., and Baragwanath, W.** Geology of the Brown Coals of Victoria. Part I. *Min. and Geol. J. Dept. Min. Vict.*, iii (6), 1949, 28–55. Part II. *Ibid.*, iv (1), 1950, 36–52.

15446. **Voisey, A. H.** The Geology of the Country around the Great Lake, Tasmania. *Proc. Roy. Soc. Tas.*, 1948, 95–103.—The general geology and physiography of portion of the Central Plateau of Tasmania are dealt with. The only rocks in the area are Jurassic dolerites, Tertiary basalts and glacial deposits.

15447. **Voisey, A. H.** The Geology of the Country between Arthur's Lakes and the Lake River. *Proc. Roy. Soc. Tas.*, 1948, 105–110.—In this area, which is on the eastern margin of the Central Plateau of Tasmania, Cambrian and Permian sediments and Jurassic dolerites have been mapped.

15448. **Walkom, A. B.** Memorial to Ernest Clayton Andrews. *Ann. Rept. Geol. Soc. Am.*, 1948, 117–120.

15449. **Whittle, A. W.** The Geology of the Boolcoomata Granite. *Trans. Roy. Soc. S. Aust.*, lxxii (2), 1949, 228–243.—This granite seems to be the product of granitization rather than of intrusion. Much detailed work remains to be done before this and other conclusions can be substantiated.

15450. **Wilson, A. F.** The Charnocktitic and Associated Rocks of North-Western South Australia. II. Dolerites from the Musgrave and Everard Ranges. *Trans. Roy. Soc. S. Aust.*, lxxii (1), 1948, 178–200.—An analysis of an olivine bronzite-bearing dolerite and much optical data are presented in a study of several Precambrian basic dykes. Several interesting mineralogical features are described, including deuteric anorthoclase, some remarkable pigeonite and other pyroxene associations, strange skeletal olivine and pleochroic olivine. Courses of basic magma crystallization are briefly discussed.

PALÆONTOLOGY.

Hon. Abstractor : H. O. Fletcher.

15451. **Brown, Ida A.** Occurrence of the Brachiopod Genus *Plectodonta* Kozlowski, at Bowning, N.S.W. *Journ. and Proc. Roy. Soc. N.S.W.*, lxxxii, 1949, 196–201.—Small fossil brachiopods occurring in the Hume Series in the Yass-Bowning district in N.S.W. are shown to belong to the Silurian genus *Plectodonta* Kozlowski; these specimens had previously been referred by

Mitchell (1923) to the Devonian genus *Stropheodonta* Hall.

15452. **Cookson, Isabel.** Lower Devonian Plant Remains. *Mem. Nat. Mus. Vict.*, xvi, 1949, 117–130.—Description of plant remains from type localities in Yeringian beds at Lilydale, Victoria. Notes on a collection from a new locality in the Siluro-Devonian sequence.

15453. **Cotton, Bernard C.** Australian Recent and Tertiary Mollusca. Family Marginellidæ. *Rec. S. Aust. Mus.*, ix (2), 1949, 197–224.—This paper presents a complete revision of Australian Recent and Tertiary Marginellidæ. Recent species number 119 and Tertiary 38, arranged into seven groups. Sixteen new Tertiary species are added, some of them having been taken from bores in the Adelaide Plains. Four new Recent species are also added.

15454. **Dodds, Betty.** Mid-Triassic Blattoidea from the Mount Crosby Insect Bed. *Univ. Qld., Dept. of Geology Pub.* iii (10), 1949, 1–14.—Six new species of the genus *Triassoblatta* are described with a record of *T. jonesi* Tillyard.

15455. **Evans, J. W.** A Re-examination of an Upper Permian Insect *Paraknightia magnifica* Evans. *Rec. Aust. Mus.*, xxii (3), 1950, 246–250.

15456. **Fletcher, H. O.** Trilobites from the Silurian of N.S.W. *Rec. Aust. Mus.*, xxii (3), 1950, 220–233.—Three new species of trilobites are described from Borenore, near Orange, N.S.W., as *Encrinurus borenorensis*, *Phacops macdonaldi* and *Dicranogmus bartonensis*. The genus *Encrinurus* is also discussed.

15457. **Gill, Edmund G.** Palæozoology and Taxonomy of Some Australian Homolonotid Trilobites. *Proc. Roy. Soc. Vict.*, lxi, 1949, 61.—Three new species are described (*Trimerus lilydalensis*, *T. kinglakensis* and *T. zeehanensis*) and two redescribed (*T. harrisoni* and *T. vomer*). The palæoecology of these trilobites is discussed; also their palæozoology with special reference to eye migration and "ornament". Finally the classification of these forms is treated.

15458. **Gill, Edmund D.** Early Tertiary Plant Beds near Pascoe Vale, Melbourne, Victoria. *Vict. Nat.*, lxvi, 1949, 69–73.

15459. **Gill, Edmund D.** Description and Biological Interpretation of some Victorian Trilobite Hypostomes. *Proc. Roy. Soc. Vict.*, lxi, 1949, 123–131.—Some Lower Devonian trilobite hypostomes are described and functions suggested for the various structures.

15460. **Gill, Edmund D.** Prosopon, a Term Proposed to Replace the Biologically Erroneous Term Ornament. *Journ. Pal.*, xxiii (5), 1949.—It is proposed that the term Prosopon be an over-all term for the description of surface appearance and it is envisaged that as palæontological knowledge increases, a number of subsidiary terms will emerge for structures of different functions.

15461. **Gill, Edmund D.** Devonian Fossils from Sandy's Creek, Gippsland, Victoria. *Mem. Nat. Mus.*, xvi, 1949, 91–115.

15462. **Glaessner, Martin F.** Mesozoic Fossils from the Snake River, Central New Guinea. *Mem. Qld. Mus.*, xii (4), 1949, 167–179.—The age of the fauna is accepted as Cretaceous and the significance of the discovery is discussed.

15463. **Harris, Wm. J., and Thomas, D. E.** Victorian Graptolites. Part XI. *Min. and Geol. Jour.*, iii (5), 1949, 52–55.

15464. **Hill, Dorothy.** The Productinæ of the Artinskian Cracow Fauna of Queensland. *Univ. of Qld. Papers, Dept. of Geology*, iii, No. 11, 1950, 1–27.—The productinid fauna of Cracow homestead comprises *Tæniothærus subquadratus* var. *cracowensis*, *Terrakea pollex*, *Anidanthus springsurensis*, *Crancrinella farleyensis*, *Horridonia mitis* and *Krotovia* sp., and these are described and the genera discussed herein. Comparison of this fauna with overseas assemblages shows that it is pre-Kungurian (i.e. pre-Permian, in accordance with the principle of priority of nomenclature) and post-*Triticites* zone of the Russian Upper Carboniferous, i.e. it is Artinskian and it seems closer to the early Artinskian (Sakmarian) than to the Upper Artinskian. The occurrence of species of the fauna elsewhere in Queensland is given.

15465. **Hill, Dorothy.** The Distribution and Sequence of Carboniferous Coral Faunas. *Geol. Mag.*, lxxxv (3), 1948, 121–148.

15466. **Hossfeld, Paul S.** The Significance of the Occurrence of Fossil Fruits in the Barossa Senkungsfeld, South Australia. *Trans. Roy. Soc. S. Aust.*, lxxii (2), 1949, 252–258.

15467. **Jersey, N. J. de.** Principal Microspore Types in the Ipswich Coals. *Univ. Qld. Dept. of Geology*, iii (9), 1949, 1–8.

15468. **Jones, O. A.** Triassic Plants from Cracow. *Proc. Roy. Soc. Qld.*, lix (3), 1948, 101–108.

15469. **Knight, O. Le M.** Fossil Insect Beds of Belmont, N.S.W. *Rec. Aust. Mus.*, xxii (3), 1950, 251–253.—The Permian fossil insect bed is discussed and an accompanying map shows the extent of the horizon.

15470. **Opik, A.** A Middle Cambrian Trilobite. *Min. and Geol. Journ.*, iii (5), 1949, 55–58.—*Centropleura neglecta* n.sp., from the *Dinesus*-Hydroid beds, Parish of Knowsley East, at Heathcote, Victoria, is represented by a single fragment of a large cranidium. The species seems to be related to the British *Centropleura pugnax* Illing (as interpreted by P. Lake) and is the first known representative of this genus in the Southern Hemisphere and in the Cambrian of the Pacific region.

15471. **Riek, E. F.** A Fossil Mecopteron from the Triassic Beds at Brookvale, N.S.W. *Rec. Aust. Mus.*, xxii (3), 1950, 254–256.—Eleven fossil specimens of Mecoptera all of the one species and represented by forewings, hindwings and portion of the body structure, are described as a new genus and species *Choristopanorpa bifasciata*. The genus has characters of both the recent *Chorista* and *Panorpa* and is very near to *Mesopanorpa* Handlirsch as emended by Martynov, 1927.

15472. **Sherrard, Kathleen.** Graptolites from Tallong and the Shoalhaven Gorge, N.S.W. *Proc. Linn. Soc. N.S.W.*, lxxiv, 1949, 62–82.—Upper Ordovician graptolites from Tallong and the Shoalhaven Gorge are described and figured, one

of them a new species. *Corynoides calicularis*, characteristic of North European and North American graptolite-bearing beds, is recorded from Australia for the first time.

15473. **Teichert, Curt.** Observations on Stratigraphy and Palæontology of Devonian. *Dept. of Supply and Develop., Bureau of Min. Resources, Geol. and Geophy., Vict.*, Rept. No. 2.—A report dealing with the stratigraphy and fossil fauna of the Devonian in Western Australia between Bugle Gap and Geikie Range in the western portion of the Kimberley Division.

15474. **Teichert, C., and Cotton, Bernard C.** A New *Aturia* from the Tertiary of South Australia. *Rec. S. Aust. Mus.*, ix (2), 1949, 255–256.—A new sub-species of *Aturia* from the Christie's Beach section, about half a mile north of Port Noarlunga, Gulf St. Vincent, is described as *Aturia clarkei attenuata*.

ENTOMOLOGY.

Hon. Abstractor : A. Musgrave.

15475. **Allman, S. L.** Skin Blemish of Nectarines Caused by Plague Thrips. *Agric. Gaz. N.S.W.*, lix (8), Aug. 1, 1948, 423–426, tfs. 1–3.—Plague Thrips, *Thrips imaginis*.

15476. **Allman, S. L.** Insect Pests. A Summary of Pests for the Year 1948–49. *Agric. Gaz. N.S.W.*, lx (8), Aug., 1949, 424–428.—Compiled from reports and information submitted by officers of the Entomological Branch. Deals with seasonal conditions, pasture and field pests, fruit pests, vegetable and flower pests, miscellaneous pests. Reprinted as Misc. Publ. N. 3,365.

15477. **Allman, S. L., and Morison, D. L.** Apiary Notes. The Effect of Newer Insecticides and Weedicides on Beekeeping Practice. *Agric. Gaz. N.S.W.*, lxi (4), April 1, 1950, 209–211, illustr.

15478. **Anderson, C. W.** Weevil in Stored Grain. *J. Dept. Agric. W.A.*, liii (9), April, 1950, 394–398, illustr.—The Rice Weevil and Granary Weevil; the Lesser Grain Borer, *Rhizopertha dominica*; Secondary pests: Flour beetles, *Tribolium* and *Iatheticus*, the Saw-toothed grain beetle, *Oryzæphilus surinamensis*; the Small red grain beetle, *Læmophlœus ferrugineous*.

15479. **Anon.** Entomological Investigations. *Commonw. Australia, 22nd Ann. Rpt. C.S.I.R., for year ended 30th June*, 1948, pp. 20–26.—General; Cattle Tick; Insect Physiology and Toxicology; Biological Control; Population Dynamics; Locusts and Grasshoppers; Pasture Cockchafers; Red-legged Earth Mite; Insect Vectors of Plant Viruses; Field Crop and Vegetable Pests; Termites; Miscellaneous Pests; Taxonomy.

15480. **Anon.** Entomology. *1st Ann. Rpt. C.S.I.R.O., for year ended 30th June*, 1949, Sect. ix, pp. 49–55.—Cattle Tick; Sheep Blowfly; Sandflies; Insect Physiology and Toxicology; Biological Control; Locusts and Grasshoppers; Pasture Cockchafers; Red-legged Earth Mite; Insect Vectors of Plant Viruses; Termites; Miscellaneous Pests; Taxonomy.

15481. **Anon.** Entomology. *Rpt. Waite Agric. Res. Inst. S. Austr., and Assoc. Act. C.S.I.R.*, 1943–47, 1950, pp. 39–45.—The Insect Pests of Stored Wheat; Insects of Pastures; Insect Pests of Horticultural Crops; Biological Control of Insects.

15482. **Bagnall, R. S.** Contributions Towards a Knowledge of the Isotomidæ (Collembola). VII–XV. *Ann. Mag. Nat. Hist.*, (12) ii (14), Feb., 1949 (=17 June, 1949), 81–96.—*Proisotomodes* n.g. Orthotype, *Isotoma bipunctata* Axelson, 1903. Monotypic. Also recorded by Womersley from Australia. *Halisotoma* n.g. Orthotype, *Isotoma maritima* Tullberg, 1871. Refers here *pritchardi* (Wom., 1936), etc. *Australotoma* n.g. Orthotype, *Isotoma* (*Isotoma*) *swani* Wom., 1934. Monotypic. W. Australia. *Folsomotoma* n.g. Orthotype, *Iso.* (*Iso.*) *bioculata* Wom., 1934 and 1939. *Australomia* n.g. Orthotype, *Folsomia loftyensis* Wom., 1934. Monotypic. S. Australia. *Arlea* Wom., 1939. Syn. *Falcisotomina* Stach, 1947. Genotype, *Isotoma lucifuga* Arle.

15483. **Beier, Max.** Neue und seltene Mantodeen aus deutschen Museen. *Ann. Nat. Mus. Wien.*, lii, 1941 (May, 1942), 126–154, 5 tfs.

15484. **Brimblecombe, A. R.** The Protection of Stored Potatoes Against the Potato Tuber Moth, *Gnorimoschema operculella* Zell. Part I. Trials in Southern Queensland. *Q'land J. Agric. Sci.*, vi (2), June, 1949, 77–83.—In a trial conducted in 1943–44 it was established that derris dust (1 per cent. rotenone) gave almost complete protection against tuber moth damage and was satisfactory for the use on both seed and table potatoes. Ground magnesite was satisfactory for the treatment of seed potatoes.

15485. **Cannon, R. C.** The Protection of Stored Potatoes Against the Potato Tuber Moth, *Gnorimoschema operculella* Zell. Part II. Trials in Northern Queensland. *Q'land J. Agric. Sci.*, vi (2), June, 1949, 84–86.—Trials in 1946 and 1947 showed derris dust (1 per cent. rotenone), magnesite and D.D.T. (2 per cent. dust) to be effective in protecting stored potatoes, and ferric oxide to be relatively ineffective.

15486. **Chamberlin, J. C.** New and Little-known False Scorpions from Various Parts of the World (Arachnida, Chelonethida), with Notes on Structural Abnormalities in Two Species. *Amer. Mus. Nov.*, No. 1430, Nov. 3, 1949, 1–57, tfs. 1–14.—*Synphyronus* (*Synph.*) *mimetus* J. C. Chamb. Syn. *Synphy. paradoxus* Tubb (*nec.* Chamb.), Lady Julia Percy Is. notes on material. ***Protochelifer*** Beier, 1948. Orthotype, ***P. nova-zealandiæ*** Beier. Key to spp. ***P. australis*** (Tubb. ***Ideochelifer***, 1937), redescription of male paratype. Lady Julia Percy Island, V. ***P. brevidigitatus*** (Tubb, ***Ideochelifer***, 1937). Lady Julia Percy Island.

Graduate Studies and Research, to be set up in the first instance to control the Doctor of Philosophy Degree and to advise the Professorial Board concerning the granting of this degree.

It is possible that in the future the Committee will extend its activities to include the control of research work within the University. At the present time the Doctor of Philosophy Degree is awarded in five Faculties, namely, Science, Engineering, Dentistry, Agriculture and Architecture, for research work carried out generally over a period of two years. Requirements for each Faculty vary slightly, and it is with a view to regulating these that the Committee has been formed.

N. W. G. Macintosh, senior lecturer in Anatomy, has been appointed to the grade of Reader. Dr. Macintosh attended post-graduate courses in the Universities of Edinburgh, London and Budapest. Geoffrey Builder has been appointed to the position of senior lecturer in Physics. Dr. Builder graduated in the University of Western Australia in 1928 and was awarded a degree of Doctor of Philosophy of the University of London in 1933 for his research on the ionosphere. He organized and directed A.W.A. Research Laboratories for seven years and has been on the staff of the Physics Department as a temporary lecturer since 1946.

D. B. Duncan, senior lecturer in Statistical Methods in the Faculty of Agriculture, resigned from the teaching staff early in August to be Associate Professor at the Virginia Polytechnic Institute in America. E. R. McCartney, who was lecturer in the Department of Chemical Engineering, has resigned his position.

C. Renwick, senior lecturer in Economics, has been granted sabbatical leave to visit the London School of Economics, Oxford University and Cambridge University and to carry out research in connexion with the Economic Theories of Ricardo. L. E. Lyons, lecturer in Physical Chemistry, has been granted an extension of leave for one year during 1952.

The degree of Doctor of Science in Agriculture has been conferred upon Robert Nicholson McCulloch, for 'Studies in the control of Chiggers'. Although the work was done under conditions of wartime urgency, for the protection of personnel against insects and mites, the records of the distribution, ecology and behaviour of the mites were made and analysed with a full appreciation of their scientific value. They resulted in an effective control of scrub typhus.

Laboratories for research upon solid fuels are to be established in the University jointly by its Department of Geology and by the Fuel Survey Division of C.S.I.R.O., to be under the joint direction of the Professor of Geology and the Senior Research Officer of the Coal Section. The cost of reorganization, equipment and staffing is to be borne by C.S.I.R.O.; the equipment and facilities will be made available for other fundamental and applied research projects in geological science.

University of Queensland

Professor Arthur Boyd, who was appointed first as lecturer in Mechanical and Electrical Engineering thirty years ago and was promoted to the status of Associate Professor in 1946, is now retiring. Enrolments of day students for 1950 amount to 1829; evening students, 1138; external students, 1147; total, 4114. In Pure Science, the numbers of day students are: first year, 79; second year, 79; third year, 49; postgraduate, 14; total 221.

The University Senate, elected for a period of three years from 1 March 1950, is as follows: Hon. William Forgan Smith (Chancellor), A. D. McGill (Deputy Chancellor), J. D. Story (Vice-Chancellor), A. E. Axon, F. C. S. Dittmer, Most Rev. James Duhig, L. D. Edwards, E. B. Freeman, A. Fryberg, Most Rev. R. C. Halse, H. J. Harvey, Rev. M. Henderson, O. S. Hirschfeld, J. H. Jones, Professor T. G. H. Jones, J. R. Kemp, R. Leggat, Clarice M. Piddington, Associate Professor E. C. D. Ringrose, Professor J. J. Stable, H. G. Watkin, Rev. H. M. Wheller, M. White.

University of Melbourne

The Chair of Civil Engineering, which is to be vacated by Professor Matheson at the end of the year, is to be filled by the appointment of A. J. Francis, of Birmingham, who is thirty-six years of age. Between 1935 and 1945 Dr. Francis was engaged on civil engineering construction works, which included air fields in Britain and harbour works in Sierra Leone. He has held a teaching and research appointment at Birmingham since the end of 1945.

Professor Friedman has resigned from the chair of Public Law in order to accept appointment as Professor of Law in the University of Toronto.

The Chair of Pathology, to be rendered vacant by the retirement of Professor MacCallum, is to be filled by the appointment of Dr. E. S. J. King. Dr. King was born in New Zealand and was educated at Melbourne High School and the University of Melbourne. He has had clinical teaching experience in pathology and surgery for many years and has at times been Acting Professor in Pathology. He is at present pathologist at the Royal Melbourne Hospital. Professor King is distinguished as an operative surgeon, morbid anatomist and clinical pathologist. He is the author of books on bone diseases and on surgery of the heart, and of some 70 scientific papers. He has been awarded the Jacksonian Prize of the Royal College of Surgeons, the Alvarenga Prize of the College of Physicians of Philadelphia, and the Syme Prize.

Dr. D. F. Gray, senior lecturer in Bacteriology, has been appointed to the status of

Associate Professor at the age of thirty-eight years. His chief researches have included immunization against whooping-cough, and the antigenic structure of *Hæmophilus pertussis*. Last year he was granted leave to act as scientific adviser to the Ethiopian Government on the manufacture of rinderpest vaccine for the Food and Agriculture Organization of the United Nations.

Professor Boyce Gibson, of the Chair of Philosophy, has accepted an appointment to the University of Birmingham, where he previously held the position of lecturer. Archibald Brown, of Glasgow and Cambridge, has been appointed senior lecturer in Mathematics. He has been for two years at the Yerkes Observatory, Chicago, on a Commonwealth Fund Fellowship.

The first Ph.D. in the Department of Bacteriology has been granted to Mrs. Rose Mushin, who has been engaged in research on aspects of gastro-enteritis.

University of Adelaide

Recent appointments include D. J. Sutton as lecturer in Physics; R. W. T. Reid as lecturer in Pathology; D. W. C. Shen as lecturer in Electrical Engineering; and H. A. Prime as lecturer in Electronic Engineering. The Chair of the Hughes Professor of Philosophy has been filled by the appointment of J. J. C. Smart, of Glasgow and Oxford, at the age of twenty-nine. Professor Smart graduated with honours in Philosophy, Mathematics and Natural Philosophy. He was an officer with the British Fourteenth Army in Burma.

University of Western Australia

A grant of five acres has been made for the building of a Women's College; a sum of £8000 is in hand for this purpose. A new laboratory is to be built for the Department of Zoology at a cost of £8250; extensions to the Department of Botany are to be provided at a cost of £6000.

Ronald Taft, formerly of Melbourne and at present engaged in research at the University of California, has been appointed senior lecturer in Psychology.

Professor A. D. Ross, who will retire from the Chair of Physics at the end of 1951 after a year's special leave of absence, is the last of the original professors appointed in 1913. He came to Australia from the University of Glasgow. Professor Ross will attend the Pan-Indian-Ocean Science Congress in Calcutta in January. He will be a delegate to the celebrations marking the five-hundredth anniversary of the foundation of the University of Glasgow in June 1951.

Personal

W. J. Simmonds has recently taken up his appointment as a Senior Fellow on the research staff of the Kanematsu Memorial Institute of Pathology of Sydney Hospital. Dr. Simmonds went abroad from the Department of Pathology of the University of Queensland in 1946, on a Nuffield Dominions Fellowship. This he held in the Department of Physiology of the University of Oxford until his return to Australia this year.

Professor J. W. H. Lugg, of the University of Malaya, has been delivering a course of lectures in plant biochemistry for two months in the University of Melbourne. Miss Jean Mills, of Melbourne, has been appointed as lecturer in Applied Nutrition in the University of Malaya.

Dr. K. L. Sutherland has returned to Australia to an appointment with the C.S.I.R.O. after working under Professor Rideal in London on the chemistry and physics of liquid surfaces, holding a fellowship of the Royal Institution. He has been awarded the Ph.D. degree of the University of London.

The John and Eric Smyth Scholarship in Education has been awarded to L. W. Shears, of Melbourne, together with an Imperial Relations Trust Fellowship. He will study for the Ph.D. degree at the University of London. A research studentship has been awarded by Trinity College, Cambridge, to C. G. Elliott, who is senior demonstrator in Botany in the University of Melbourne. A fellowship for the study of solar physics has been awarded by Harvard College Observatory to F. J. Kerr, of the C.S.I.R.O. Radiophysics Laboratory.

Dr. D. P. Madigan has been awarded the David Grant Scholarship, which consists of a medal and a sum of £70. An 1851 Exhibition has been awarded to F. J. Fensham, who has been investigating self-diffusion of tin by the use of radioactive tin and who will work under Professor W. E. Garner at Bristol; also to D. G. Gillam, who will study under Professor Lamb in the Department of Physical Chemistry at the Royal Institute of Technology, Stockholm. Both of these awards go to members of the Department of Chemistry in the University of Melbourne.

Professor C. E. Weatherburn, of the University of Western Australia, has been invited by the University of Glasgow to attend the cinquennial celebrations of the University and to receive the honorary degree of Doctor of Laws. Professor S. Warren Carey, of the University of Tasmania, will be a delegate to the Pan-Indian Science Congress to be held in Calcutta next January.

Emeritus Professor R. D. Watt, of the University of Sydney, has been awarded the Farrer Medal for distinguished services to Australian agriculture. Dr. E. G. Hallsworth, of the University of Sydney, has been appointed to the Chair of Agricultural Chemistry in the University of Nottingham.

In connexion with the joint Norwegian-British-Swedish expedition to the Antarctic, J. E. Jelbart, of Melbourne, has been appointed

as Australian observer. He will assist with the glaciological and physical research programme and will leave Oslo with the ship *Norsal* in November.

The Societies

Royal Society of New South Wales
August: J. A. Dulhunty, Nora Hinder and Ruth Penrose, Rank variation in the Central Eastern Coalfields of N.S.W.
S. E. Livingstone and R. A. Plowman, Studies in the chemistry of platinum complexes. IV, Oxidation of ions of the tetrammine platinum-II type with hydrogen peroxide.
September: C. M. Harris, Co-ordination compounds of copper. II, Compounds derived from copper-I iodide.
A. J. Lambeth (lecture), A geologist on Heard Island and Gerguelen Island.
October: F. P. Dwyer and J. W. Hogarth, The chemistry of osmium. VII, The bromo- and chloro-pentammine osmium-III series.
F. P. Dwyer and E. C. Gyarfas, The oxidation of iridium-III salt solutions.
L. E. Maley, Physical Investigations on complexes of diphenylthiocarbazone.
G. D. Osborne (lecture), Evidence against granitization in large unstressed bathyliths.

Royal Society of Queensland
June: E. Singer (lecture), Four years in China.
July: I. M. Mackerras and M. J. Mackerras, *Aphistomyia collini* Bezzi (Diptera, Blepharoceridae) in North Queensland.
W. Stephenson (lecture), Preliminary experiments upon the evolution of phosphates from estuarine muds.
September: Films.

Royal Society of South Australia
September: Symposium—Fauna and flora conservation.
October: A. P. Wymond and R. B. Wilson, An occurrence of crocidolite near Robertstown, S.A.
T. H. Johnston and L. M. Angel, The life history of *Plagiorchis jaenschi*, a new trematode from the Australian Water Rat.
I. M. Thomas, *Craspedacusta sowerbyi* in South Australia, with some notes on its habits.
R. L. Specht, A reconnaissance survey of the soils and vegetation of the Hundreds of Tatiara, Wirrega and Stirling, Co. Buckingham, S.A.

Royal Society of Tasmania
September (R. M. Johnston Memorial Lecture): J. T. Wilson, The development of continents and oceans.
October: H. N. Barber, Scientific freedom in the Soviet Union.

Royal Society of Victoria
September: J. Tuzo Wilson (Professor of Geophysics, University of Toronto), Geophysical methods in the study of continental structure.
October: H. T. Clifford, The ecology of the Dandenong Range.

Royal Society of Western Australia
September: D. H. Perry, Methods of controlling coastal sand drift in Western Australia.
B. J. Grieve, Sand dune ecology.
October: L. Glauert (lecture), Whales and their allies.

Papua and New Guinea Scientific Society
September: W. Granger, The problems of the animal industry in the Territory.

Institute of Physics, Australian Branch, N.S.W. Division
September: G. K. White, Developments in low-temperature physics.
October: Inspection of the Division of Metrology, National Standards Laboratory, C.S.I.R.O.

Medical Sciences Club of South Australia
September: Dr. Milthorpe, The mechanism and biological significance of stomatal movements.
A. A. Abbie, Some impressions of medical education in the United States.
October: B. S. Hetzel, The adrenal cortex in hypertension.
D. C. Hine, Biological assay of glucortinoids.

Victorian Society of Pathology and Experimental Medicine
September (special meeting): Professor Brian Macgraith (Liverpool), The pathogenesis of lesions, particularly those of the liver, seen in malaria and other related tropical diseases.
October: F. C. Courtice, Extravascular protein and its lymphatic absorption from various regions of the body.

Royal Australian Chemical Institute
Council 1950-1951: S. B. Watkins (President), J. Poppleton (Vice-Pres.), G. Junck (Hon. Treas.), H. W. Strong (Hon. Sec.), J. Cuming, H. E. Hill, A. W. Peirce, V. S. Rawson, H. L. Wood.
Registrar: E. N. Dimmock, 55 Collins Place, Melbourne.
New South Wales: V. S. Rawson (President); M. B. Walters (Secretary), 39 Martin Place, Sydney.
Queensland: H. L. Wood (President); J. R. Hinchley (Secretary), 62 Eagle Street, Brisbane.
South Australia: A. W. Pierce (President); G. B. Jones (Secretary), 4 Mawson Street, Nailsworth.
Tasmania: H. E. Hill (President); F. H. C. Kelly (Secretary), 152 Augusta Road, New Town.
Victoria: J. Poppleton (President); R. C. Edquist (Secretary), 55 Collins Place, Melbourne.
Western Australia: J. Cuming (President); R. H. Pearce (Secretary), 10 Railway Parade, West Perth.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

Asbestos Partition Chromatography

The technique of paper chromatography has been found useful in the separation of inorganic ions. Papers may be impregnated with surface active adsorbents or ions exchangers (Iijima and Sato, 1944; Flood, 1940). Longenecker (1949) used previously-boiled string, cotton thread, glass wool and thin asbestos paper to accomplish descending and ascending separation on a micro scale.

Asbestos millboard has been used to effect qualitative separation of some cations from solutions. The millboard was cut in longitudinal sections, each slice a little longer than a test tube, and in width just somewhat narrower than the width of the tube, so that it could pass grazing inside and stand perfectly vertical in the tube. The slices were designed to be placed with one of their ends dipped in water (three to four cc.) in the test tubes. A drop of the test solution (previously acidified with hydrochloric acid) was put on the slice on its flat face, at about one-and-a-half to two inches from the mark where the edge of the water would stand when the slice was placed in the tube. When the drop had been completely soaked in, the slice was set in the tube already containing the required volume of water for the experiment.

Water gradually rose through the slice up to the mark where the drop had been put. It was allowed to rise further till it passed well beyond the mark, when ultimately there was no further appreciable rise. The slice was then taken out while still moist and placed in a slow current of hydrogen sulphide gas. It was found that the sulphides formed had the tendency of separating in bands. With a copper-cadmium test solution, a yellow and black band appeared. With an arsenic-antimony-tin solution also, rings appeared with the typical colours of the sulphides.

It would appear that this new adsorbant may be used instead of impregnated papers.

Binayendra Nath Sen.

Chemical Laboratory,
Burdwan Raj College,
Burdwan, West Bengal,
India.
21 July 1950.

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Goto and Kakita (1942): *J. Chem. Soc. Japan*, *63*, 120.
Flood, H. (1940): *Z. Anal. Chem.*, *120*, 327.
Iijima, S., Sato, T., and Kamoshita, T. (1944): *Bull. Inst. Phys. Chem. Research Tokyo Chem. Ed.*, *23*, 233.
Longenecker, W. H. (1949): *Anal. Chem.*, *21*, 1402.

Notes on the Culicidae of Central Western New South Wales following the 1950 Floods

The Narromine and Trangie district was visited twice this year primarily for the purpose of recording observations on the habits, and collecting specimens, of the Australian Bush Fly *Musca vetustissima*. Owing to the extremely heavy flooding of the region during this year, the population of mosquitoes was very high, so some general observations were recorded on it and specimens were collected. All specimens were kindly identified by D. J. Lee of the School of Public Health and Tropical Medicine.

In early April the district was subject to heavy flooding and large areas were covered with a considerable depth of water, filling depressions which are still holding water that will remain until it evaporates. During the first visit, from 2 to 8 May, mosquitoes were active and numerous. Specimens collected were *Anopheles annulipes*, *Culex fatigans*, *C. annulirostris*, *Aedes alternans*, *A. alboannulatus*, *A. theobaldi* and *A. vittiger*. *A. theobaldi* was dominant.

Between May and August, the time of the second visit, rain fell almost continuously. On this occasion, in certain well-grassed and fairly heavily-timbered country, the mosquitoes were in enormous numbers. This locality was very damp but did not contain surface water, although it was surrounded by many square miles of swampy country. The mosquitoes were so thick in this place that when they settled on men or animals it would have been difficult to put a pin between them without touching them. Besides biting, the mosquitoes entered the mouth, nose and eyes and made it practically impossible to remain in the area. Losses of dogs were reported to me.

The weather was quite cool and at times a fairly strong south-westerly wind was blowing. In spite of what appeared to be adverse conditions, the mosquitoes were present throughout the day. They were most numerous and bit most persistently about mid-day, when only Culicines were present. In the late afternoon Anophelines started to make their appearance and became quite numerous and bit freely after sunset, when the temperature was well below 50°F, and there had been a frost the previous night. After sunset the mosquitoes left the grass and could be seen, silhouetted against the twilight, to be swarming upwards in several funnel-shaped patches. Specimens taken were *Anopheles annulipes*, *Aedes theobaldi*, *A. alboannulatus*, *A. occidentalis*, and *A. theobaldi eidvoldensis*. Males of *A. theobaldi* and *A. alboannulatus* were taken.

An extensive search was made for larvae but the only ones found were *Aedes alternans* of varying sizes. No adult *A. alternans* were taken.

P. C. Minter.

Department of Zoology,
University of Sydney.
6 September 1950.

Occurrence of Saponins in Spear-Lilies

During the course of the past few years we have been carrying out a survey of Australian plants for the presence of saponins. Interest in saponins of the steroidal type has recently increased since it has been shown that they may serve as starting materials for the partial synthesis of some steroidal hormones and related compounds.

Many plants encountered in our survey show promise in this regard. In particular two members of the family Amaryllidaceae subfamily 2, *Agavoideae* (Rendle 1930), namely

Doryanthes excelsa Corr. and *D. Palmeri* W. Hill, gave, in both the roots and leaf bases, exceptionally good positive tests for saponin. Both of these plants are commonly referred to as Spear Lilies or Giant Lilies, growing along the eastern coastline, and are members of an exclusively Australian genus. Marker and co-workers (1943) have isolated steroidal saponins from some other members of this sub-family, e.g., *Agave americana*, L.

Isolation of the saponin from *D. Palmeri* and its chemical investigation have resulted in the isolation of two crystalline sapogenins, the detailed structures of which are currently being investigated.

The saponin of *D. excelsa* is also under chemical examination together with those from certain other plants which gave tests indicative of the presence of steroidal saponins. Among the more promising of these are *Cordyline terminalis* Kunth. and certain *Dioscorea* species.

W. J. Dunstan,
J. J. Simes.

Chemistry Department,
Sydney Technical College.
August 1950.

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Marker, R. E., *et alii* (1943): *J. Amer. Chem. Soc.*, 65, 1199.
Rendle, A. B. (1930): The Classification of Flowering Plants, Vol. I, 308. Cambridge: University Press.

Air-borne Contamination from Animal Houses

It is important to know whether the precautions taken to prevent spread of infection from an animal house really are adequate. Direct contamination from contact, etc., can be tested by well-established techniques, but it is not so easy to determine what may happen to organisms that are disseminated into the air. We were faced with this difficulty in a newly-constructed experimental animal room at this Institute, and it was decided to test the point by using a harmless, distinctive fungus which produced large numbers of light, air-borne spores. *Spicaria divaricata* (Thom.) Gilman and Abbott was chosen, because it fulfilled these conditions, had not been found in preliminary surveys of the area, and grew rapidly at 37°C.

The Institute at present occupies a large army hut, raised on stumps, with the laboratories above and the animal rooms beneath. These have impervious plaster walls and ceilings, windows (closed by louvres) on one side, and a ventilation shaft leading from the ceiling up through the building and above the roof topped by a 'rotovent'. The shafts are carefully sealed against leakage of air, and the intention is that air circulation in the rooms should be in through the door and windows and out up the shaft to the open sky above.

The experiment commenced at noon on Saturday when work in the experimental animal room was finished. While both door and windows were closed, spores were dispersed by agitating plate cultures on a shaker for ten minutes. Before leaving, the louvres of the windows were opened about one-fourth but the door was kept shut. The main building was not re-entered by the experimenter in order to avoid contaminating it. No one visited the animal room during the week-end, and only the caretaker and cleaners entered the laboratories above.

From 8 to 9 a.m. on Monday morning, before any of the staff had arrived, two Czapek's agar plates were exposed in each of five widely-dispersed rooms on the main floor. Further collections were made at 2 and 4 p.m. during a day of normal activity, in the course of which one member of the staff spent some time in the experimental animal room and subsequently worked in laboratory E. The cultures were incubated for three days, with the results shown in the table.

Laboratory	Distance from experimental animal room	Colonies of *S. divaricata* 8-9 a.m.	2-3 p.m.	4-5 p.m.
A	120 ft	5	0	0
B	56 ft	4	0	0
C	66 ft	3	0	0
D	Partly above	4	1	0
E	Partly above	1	12	2

Clearly, there had been escape of spores of *S. divaricata* during the week-end, and it seems evident that a worker brought additional spores out during Monday's activities. The purpose of this note, however, is not to discuss the extent of the dispersal nor the measures that are being taken to meet the situation revealed, but to call attention to a method of testing which is simple and sensitive and which it is hoped may be useful to other workers.

R. E. Stewart.

Queensland Institute of Medical Research,
Brisbane.
29 September 1950.

Land Classification in Australia

I refer to the article under the above title, by J. K. Taylor,* with particular reference to the notes concerning the work of the Queensland Bureau of Investigation. Mr. Taylor appears to have misunderstood the functions of the Bureau and its relationship to the other State departments. The Bureau is charged with the investigation and planned use of the land and water resources of the State and is composed of senior officers of all State departments concerned with land and water use, together with a staff of two technical officers who carry out the field work. Where sufficient information about any area is available in any of the State department files, the Bureau takes action accordingly. Where insufficient information exists the

* This Journal, 12, 127, February 1950.

Bureau asks its officers to carry out a broad preliminary survey of the area for the purpose of gauging the potentialities of the area in question. After this, if deemed necessary, it asks for a more detailed investigation of the area or part thereof considered to require further investigation, and this detailed investigation is carried out by the department specially concerned.

The Bureau frequently deals with problems of immediate importance in Government policy and information is therefore required urgently. Time is not available for detailed investigation of large areas, but with the assistance of aerial photographs and limited ground traverses it is possible for the Bureau field officers, who have a sound practical agricultural and pastoral background, to present a fairly reliable picture of the potentialities of the area under consideration.

The first report of the field officers of the Bureau was made in October 1945, or just about five years ago. Since then, with never more than two officers in the field, an area of 37,000,000 acres of Queensland has been classified in sufficient detail for Government action, in addition to the publication of a Land Use Map of the State. When it is considered that the above acreage has included the South-west Channel Country of Queensland, the Queensland-British Food Corporation farming areas and the Burdekin irrigation area, on the reports of which Government action has already been taken, it will be seen how valuable this work is to Queensland. The simple classification into 'arable and non-arable' land referred to by Mr. Taylor included some 250,000 acres of the Queensland-British Food Corporation's interests made up largely of one soil group, with closely related soils, all of which are subject to similar cultural treatment. The amount of arable land was necessary information for the Corporation, which has made very real use of the maps prepared by the Bureau.

It should be mentioned that the maps have been drawn up for the immediate requirements of this State, but soil profile notes including location, type, and complete chemical and mechanical analyses coupled with associated vegetation are on the Bureau files and are available for more detailed mapping according to academic standards, if desired. It is not the intention of the Bureau officers to name any specific soil type, as it is considered that this should be the province of those (probably the State Department of Agriculture teams) who are charged with the detailed surveys of the soils of the particular areas.

P. J. SKERMAN,
Agricultural Resources Officer.

Bureau of Investigation,
Dept. of Public Lands,
Brisbane.
5 September 1950.

The Zoogeography of the Diptera

In my recent paper (This JOURNAL, *12*, 161) I expressed doubt whether anyone knew where *Hermetia illucens* Latr. came from. Professor T. Harvey Johnston, out of his vast fund of knowledge, has been good enough to give me the answer. It was introduced in decomposing prickly pear in the course of the work on the biological control of that pest (Johnston, T. H.: *Q'land Agric. J.*, *16*, 67 (1921); *17*, 239 (1922); *Rpt. Aust. Ass. Adv. Sci.*, *16*, 380 (1924)).

I. M. MACKERRAS.

Queensland Institute of Medical
Research.
22 September 1950.

Views

Removal of Metal Ions from Solution

We hasten to comment on a letter* by Dr. D. P. Mellor entitled 'A Possible Method for the Removal of Trace Elements from Solutions' (This JOURNAL, *12*, 183) which, owing to delay in publication of the April issue of the JOURNAL, has only just come to our notice. For many months past we have been engaged, among other studies, with the synthesis of relatively insoluble substances with giant molecules containing many chelate groups which might well be expected to bind certain metallic cations very firmly indeed, and thus be capable of removing them completely from solution. This work was conceived and commenced by us in 1949 in an endeavour to find an adequate solution to the difficult problem in bacterial nutrition studies of preparing metal-free media —a problem posed for us by a member of the Department of Bacteriology of this University.

Dr. Mellor states: 'It might not be feasible to polymerize 8-hydroxyquinoline itself to form a suitable ion-exchanging resin, but there are possibly other organic reagents capable not only of forming very stable metal complexes but also of being suitably polymerized'. We are at a loss to understand what he means by polymerizing 8-hydroxyquinoline. Most chemists would agree that it cannot be polymerized. It could, of course, be incorporated as a starting material in resins of the phenol-formaldehyde type, and such resins might have some value. In such resins, however, most of the 5- and 7-positions of each quinoline residue would be blocked by substituted benzyl groups, and such blocking could interfere with the co-ordinating capacity of the 8-hydroxyquinoline residue. It should also be remembered that the metallic cations whose elimination from solution is sought are rarely univalent, and combine with more than one bidentate chelate molecule of 8-hydroxyquinoline type when forming stable

* The absence of the sub-title, 'Views', above this letter was an editorial omission (*Ed., A.J.S.*).

complexes. For complex formation of the usual type it would be necessary for the metal atoms to function as cross-links between the chains in which the 8-hydroxyquinoline residues are incorporated.

In our own approach to the problem we have sought to prepare not so much ion-exchange resins as giant-molecular, metal-ion binding substances which would hold combined metal ions so firmly as to be incapable of easy regeneration. We have pursued two main lines of attack which can be illustrated by mentioning two examples. The first, which we consider the more promising, aims at the preparation of a giant linear molecules with repeated quadridentate chelate units obtained by such a method as the condensation of 4:4′dihydroxy-3:3′-dialdehydo-diphenylmethane with ethylene diamine. In the second method some such substance as 2-hydroxy-3-methoxy-5-aminomethyl-benzaldehyde is induced to condense with itself to a high-molecular-weight substance whose molecules contain the repeated bidentate *o*-hydroxy-benzylidene-amino chelate group. Substances of this type, again, would require combining metal atoms to function as cross-links between chains.

We have also been concerned to produce 'double-ended' bis-bidentate chelate compounds, such as 8:8′-dihydroxy-5:5′-biquinolyl, combination of which with multivalent metallic ions should lead to formation of relatively insoluble substances whose giant molecules are held together by the metal atoms as essential links in the chain.

The results of all these studies will be published later in the usually accepted way when the researches are complete.

F. P. DWYER,
NAIDA S. GILL,
E. C. GYARFAS,
FRANCIS LIONS.

Department of Chemistry,
The University of Sydney.
September 1950.

There are a number of different ways besides precipitation in which metal ions in solution may be deactivated. They may be made to combine with a soluble ion-exchanger such as ethylenediamine tetra-acetic acid, a substance that is now being used industrially* for deactivating heavy metal and alkaline earth ions (Zussman, 1949).

Another method is that outlined above by Dr. Dwyer and his collaborators, namely, to use relatively insoluble substances with giant molecules containing many chelate groups able to combine with metal ions so firmly as to be incapable of easy regeneration. Relatively insoluble substances of this kind would, if used in absorbing columns, be likely to suffer from the same disadvantages as a column of 8-hydroxyquinoline (Erlenmeyer and Dahn, 1939; Meinhard, 1949). A third method is to use synthetic ion-exchanging resins whose open, sponge-like structure endows them with high exchange capacity. For most effective functioning, a resin of this kind must be extremely insoluble (Bauman, 1949), and if it is to be used in a cyclical process the resin must also be capable of regeneration. It was with this type of substance only that the suggestion made in my former letter was concerned. Admittedly the term polymerize was used loosely in that communication. As surmized by Dwyer *et al.*, it was intended to indicate the incorporation of substances like 8-hydroxyquinoline in resins of the phenol-formaldehyde type. Using 8-hydroxyquinoline, I have made attempts to do this, but without success.

It is not essential, as Dwyer *et al.*, imply, that a bivalent metal ion should combine with more than one bidentate chelate molecule. There is no reason why four-covalent copper, for example, should not combine with one bidentate chelate and two water molecules. Some experiments by L. E. Maley (unpublished) suggest that copper can be attached to a resin by less than four of its covalent bonds. The blocking of the 5- and 7- positions of each quinoline residue by substituted benzyl groups in the kind of resin proposed would not therefore necessarily prevent the binding of copper atoms. Certainly attachment of a copper atom to a resin by four bonds would bind it more firmly. Though there is as yet no direct evidence on the point, it seems probable that copper atoms are bound to resins now in common use by chelate rings engaging at least two of the metal atom's four possible bonds.

The astonishingly clear-cut separations of rare earths brought about with synthetic resins (Tompkins, Khym and Cohn, 1947) were achieved mainly by markedly increasing the separation factor by the use of external complexing agents such as ammonium citrate. For some purposes, it would seem worthwhile to try to make the resin itself more selective.

In order to deactivate one species of metal ion in the presence of large amounts of other ionic species—for example, to remove silver from sea-water or traces of copper from magnesium sulphate—a resin would need to be not only selective but capable of combining with extremely small amounts of the trace metals.

There is nothing new in the use of synthetic resins for recovering traces of metals from solutions (Sussman and Nachod, 1949). It was the main purpose of my recent letter to suggest that resins, more selective and more effective*

* Under the name 'sequestrene'.

* In the sense of their being able to reduce concentrations of trace metals to still lower values. To test the efficacy of resins at such low concentrations would probably require the use of radioactive tracer atoms.

than those in present use, might be made by incorporating within their structures chelate-ring-forming groups known to be highly selective, which, from stability-constant measurements, would be expected to bind metal ions firmly. It might be difficult to regenerate this kind of resin since, to do so, would require still more powerful complex-forming substances.

Should it prove practicable to make such highly selective resins, their inability to be regenerated need cause no serious disadvantage where their use is restricted to the purification of small amounts of solution or to the recovery of sufficiently valuable trace metals.

D. P. MELLOR.

Department of Chemistry,
The University of Sydney.
September 1950.

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Reviews

Biochemistry

VITAMIN METHODS. Volume I. Edited by Paul György. (New York: Academic Press, 1950. 571 + viii pp., 19 text-figs., 27 tables. 6″ × 9″.) Price, $10.00.

Substances classed as vitamins include a wide variety of compounds. As essential constituents of the diet, methods for their estimation are of considerable practical importance as well as of scientific interest. These methods are almost as varied as the compounds to be determined. They range from precise optical measurements to rather crude observations on animals. Difficulties are often increased by the small quantities of material available for analysis, and by complex and unsatisfactory methods of separation from the materials in which they occur. There is thus ample scope for the treatise on methods of determining vitamins which Paul György has undertaken to edit. The work is in two volumes, of which the first is now available. This volume deals with physical, chemical, microchemical, microbiological methods. It includes a brief discussion of the principles of colorimetry, photometry and fluorimetry, in which a few representative optical instruments are described in detail. Seven authors, including the editor, contribute the different sections of this volume.

The several types of method are dealt with at length in connexion with the particular vitamins for which they have been found suitable. Where necessary the principles of methods used are discussed, although this treatment involves some overlap of the section on physical methods and that on the principles of optical methods. For most of the methods considered, all the details necessary for carrying out the estimations are given.

Methods classed as chemical are more generally applicable, They exist for most of the vitamins, although more specialized methods are often more convenient. For example, certain vitamins have optical properties which can readily be measured, or their effect on the growth of some easily cultured organisms may be easy to measure. Indeed, their effect on selected living organisms is at present the only means of detecting some of the more recently discovered vitamins. As enzymes were, in the early days of investigating them, so these vitamins are recognized only by their effects.

The section on microchemical methods is more general than the others. In it there is a description of methods for the measurement, titration and colorimetry of volumes of specimen of only a few cubic millimetres. The vitamins considered are vitamin A and its provitamins, ascorbic acid, and riboflavin. Micro methods for the determination of phosphatase, iron and protein are described also, although the reason for their inclusion is not apparent.

Each section has its own comprehensive list of references. In addition there is a complete general author index and a subject index. The book is very well produced. It should prove invaluable to all workers concerned with the investigation of vitamins. The appearance of the second volume will be awaited with interest.

H. S. HALCRO WARDLAW.

Botany

VEGETABLE GUMS AND RESINS. By F. N. Howes. Plant Science Books, Volume 20. (Waltham: Chronica Botanica; Melbourne: N. H. Seward, 1949. 188 pp., 39 text-figs. 6¾″ × 10¼″.) Price, $5.00.

The purpose of a book of this kind should be to bring together the history, origin, geographical distribution, composition, and uses of a group of substances in such a way that it will be at once an authentic record and a reference book for all who are interested. Special attention should be paid to the needs of handlers of the substances, and especially of research workers in the particular field.

The author has only partly succeeded in this objective. In a number of cases he has written first-class accounts of the collection, preparation for commerce, and uses of vegetable gums and resins. When it is realized that most of the relevant scattered literature of three-quarters of a century has been summarized in

a volume of 188 pages, the courage of the author in undertaking the task is evident. A very good overall picture has been placed before the general reader.

In his capacity as a botanist, Howes has done an excellent job. He has provided the merchant and trader, the chemist and technologist, with authentic information regarding the botanical sources of natural gums and resins. Only those who handle plant products, commercial or otherwise, are able to appreciate the satisfaction and peace of mind resulting from confidence in botanical diagnoses.

It is when he deals with the chemical and technological aspects of gums and resins that the weaknesses appear. Without some first-hand knowledge it is difficult for an author to interpret the results of others who work in specialized fields. Extracts and quotations from the literature are numerous, and always fully acknowledged, but the conclusions drawn are often vague and of little value.

Thus the quotation on pages 91 and 92 dealing with 'copal type synthetic resins' is difficult for the general reader to follow, while the technologist would prefer to study the original article. On the other hand, some definition of 'run' and 'bloom', as applied to varnishes, might well have been given for the benefit of the general reader.

The statement in the introductory paragraph dealing with resins—'they . . . usually dissolve readily in alcohol, ether, carbon bisulphide and certain other solvents'—is ambiguous, since very few natural resins are completely soluble in more than one or two organic solvents without previous treatment.

A description of gum chicle, used so largely in chewing-gum manufacture, may have been omitted deliberately; but the fact that this plant product consists partly of a gum warrants its inclusion.

The bibliography is comprehensive and, in general, a credit to the author. Probably the most authoritative up-to-date account of Kauri resin, however, *Kauri Resin in Varnishes, Lacquers and Paints*, by J. R. Hosking, issued by the Research Association of British Paint, Colour and Varnish Manufacturers, England, should not have been overlooked.

The table of contents, indices and bibliography are well set out; the former rather comprehensively for a book of 188 pages, but nevertheless excellent for quick reference. As might have been expected from the publishers, the format and printing of the book are good and typographical errors almost nil. The price is perhaps not excessive in the United States or the United Kingdom, but would certainly be rather high in Australia.

To sum up, from the title one would have expected a first-hand treatment of the subject. Written in collaboration with a chemist or technologist specializing in gums and resins, the result would probably have been a standard text-book. As it stands, a Kew bulletin, embracing botanical information and the gathering of gums and resins, together with the bibliography, should have satisfied the author and would have satisfied his readers.

F. R. MORRISON.

Chemistry

PHYSICAL METHODS IN CHEMICAL ANALYSIS. Volume I. Edited by Walter G. Berl. (New York: Academic Press, 1950. 664 pp., numerous text-figs., 11 tables. 6¼" × 9¼".) Price, $12.00.

As a collection of monographs on a number of physical methods used in chemistry, this book has considerable merit, but as a volume on the application of physical methods in chemical analysis it does not fulfil its intentions.

The conception of such a book is admirable and most of the contributors are authorities on their subjects, but few of the contributions give more than a restricted discussion of the analytical applications. The various chapters are quite uncoordinated and the use of two or more methods in conjunction is not even mentioned. This independence leads to repetition of the same material in different parts of the book. For instance, the table of β-filters for X-rays is given on pages 21 and 114; commercial X-ray diffraction equipment is described at length in Chapters 2 and 3; low-angle X-ray scattering is discussed twice (pages 69-74 and pages 157-161).

Considering the chapters independently and without emphasis on the title of the whole volume reveals a number of valuable reviews. The chapters on infra-red spectroscopy (H. H. Nielsen and R. A. Oetjen), Roman spectroscopy (J. H. Hibben), electron microscopy (R. D. Heidenreich) and mass spectroscopy (H. W. Washburn) are excellent. There are other chapters on X-ray and γ-ray absorption, X-ray diffraction, electron diffraction, spectrophotometry and colorimetry, emission spectrography, polariscopic and polarimetric examination in transmitted light and refractive index measurement. This first volume is concerned mainly with those phenomena which involve the interaction of radiation with matter. The second volume will be concerned with a more miscellaneous collection of analytical methods.

It is surprising to find in the chapter on spectrophotometry and colorimetry (W. R. Brode) a quite serious suggestion (page 198), at the expense of dimensional rigour, that wave number should be expressed as waves per 100 cm. or cm^{-2}. In the same chapter one finds a diagram of six absorption spectra (Fig. 7, page 205) without a clue as to their identity either

in the caption or in the text; and the colour of a black body at 2800°K at the centroid of the I.C.I. chromaticity diagram (Fig. 47, page 249). Numerous minor errors attributable to inadequate proof-reading are evident; for example, seven names among those whose work is known to the reviewer are mis-spelt.

This book will undoubtedly have a wide circulation and will indeed be valuable; it will, however, leave those who read it on its title somewhat disappointed.

A. L. G. REES.

Ecology

ADAPTATION AND ORIGIN IN THE PLANT WORLD. The Role of Environment in Evolution. By F. E. Clements, E. V. Martin and F. L. Long. (Waltham, Massachusetts: Chronica Botanica; Melbourne: N. H. Seward, 1950. 332 pp., 85 plates, 47 tables, 7 text-figs., 21 graphs. 6″ × 9¼″.) Price, $6.00.

One would have liked to hail this book—the last written by one of the best-known of twentieth-century ecologists — as a *magnum opus*, a masterpiece, a fitting crown to a lifetime's work: but it is an irritating book, an exasperating book, and in the main a disappointing book, strongly suggesting the mountain which laboured to bring forth a mouse.

During the period from 1905 to 1945 a team under the leadership of Dr. Clements and the auspices of the Carnegie Institution had set up a number of experimental gardens in Colorado and California, with the purpose of studying the changes induced in plants by differences in natural environments. It was intended to publish the results in a series of four volumes, of which the first appeared in 1939 and dealt with work in coastal dunes. In 1945, when the material for the second and third volumes was almost ready, Dr. Clements and one of his principal collaborators, Dr. Long, died; the material was accordingly assembled and edited by Mrs. Clements for publication as a single book.

The first part of the book deals with work in California, where the gardens had facilities for keeping plants under different conditions of water supply, soil type, mineral nutrition, light intensity and length of day. Observations were made on the growth rate, transpiration rate and stomatal distribution of a wide variety of species under these conditions, as well as on changes in their habit and time of flowering. The second part is concerned with work in Colorado, where gardens were maintained at three altitudes (6,000 feet, 8,000 feet and 12,000 feet), and in each some variation in environmental factors was possible. Observations of the same type as those in California were made in Colorado, many species being transplanted between the various environments under study.

The major part of the results recorded are of a rather pedestrian type, often serving merely to confirm facts already generally known; the environmental factors were often not separated sufficiently to justify far-reaching conclusions. Perhaps the most interesting results are those in which the characteristics of closely-related species are shown to be interconvertible under suitable environmental conditions. One would like to know whether there were any sterility barriers between these species, and whether the physiology and viability of the morphologically similar forms differed.

The authors appear to take a rather Lamarckian view of the evolutionary process, regarding it as consisting first in adaptation (which to them means any plastic modification of the individual induced by the environment), and then in the 'fixation' of these 'adapted' characters. At one point they even make the startling statements that 'mutants are produced by direct factors operating through the nutrition stream to the different organs' (p. 171); but a close search revealed no evidence in support of this.

The book is marred throughout by the lack of many details concerning the methods of work and the results obtained, which the reader needs in order properly to evaluate the conclusions drawn. It is also marred by an obscure and often ambiguous style, making much use of words specially invented where existing words or phrases would be quite adequate; e.g., 'ece' for 'environment'; 'ecesis' or 'ecogenesis' for 'adaptation'; 'holard' for 'soil water content'; 'specient' for 'individual'.

The work is profusely illustrated with plates of high quality, two in colour. Graphs and most tables are relegated to the ends of the two main sections, and the tables are reproduced in facsimile typescript—a surprising feature in a book on whose production a great deal of expense has clearly been lavished. In the numbering of the tables, Nos. 1 to 13 have unfortunately been duplicated. An index to plant names is provided, but in the Addendum to this index the majority of the entries seem to be wrong. A very incomplete list of references is also included.

D. W. GOODALL.

Embryology

AN INTRODUCTION TO VERTEBRATE EMBRYOLOGY. Second Edition. By H. L. Wieman. (New York: McGraw-Hill, 1949. 412 + x pp., 247 text-figs. 6″ × 9″.) Price, $5.00.

In his preface the author states that he has aimed at producing a text which premedical students can use to advantage; it is not directly concerned with the needs of the general student. To be perfectly fair to the author, the book should be reviewed from the angle of pre-

medical requirements, but the reviewer is not completely clear as to the meaning of this phrase in American universities. Perhaps it signifies 'at the anatomy school level'. If this is the case, then the book definitely succeeds in its purpose.

If, on the other hand, the general reader expects to find in this—at last—a really good general work on vertebrate embryology, then he will be disappointed. Such a book—although badly needed—has not yet been written. Once again though, this is not fair to the author, whose aim has been a specialized one.

After two short chapters dealing respectively with development in general, and the cellular basis of development, there follows a compressed description of the early embryology of the frog. It was an agreeable surprise to find an account of the experimental embryology of the Amphibia; for some reason many American authors appear to avoid this and stick to the old factual account of frog development without any reference to the dynamical aspect as revealed by the work of Spemann, Vogt, Goerttler, and their successors.

It is to be regretted that Wieman has relegated this aspect of Amphibian development to an Appendix instead of incorporating it in the chapter on the frog as part of the general description of gastrulation. The latter, never easy for students to understand, is made much more intelligible when treated from the viewpoint of presumptive areas, and the movement and final location of these during gastrulation.

The following five chapters are devoted to the embryology of the chick. These are well done, especially those on the nervous system and sense organs, and the circulatory system; but here, too, data on experimental work are put into the Appendix. The style of writing in these chapters, as elsewhere, is rather terse, but the author more than makes up for this by frequent reference to physiological and biochemical aspects of development, such as are not usually found in the average text-book.

The chapter on the intra-uterine development of mammals is rather disappointing in that it could have included more information on the structure, functioning and fate of the placenta. This is a fault that it has in common with most text-books of vertebrate embryology.

The final four chapters, occupying almost half of the entire book, are concerned with the development of the pig and of man, and are easily the best; they contain much new material on the early development of the human embryo and on prenatal human growth. Teachers of advanced vertebrate embryology will find these chapters very useful.

The prospectus on the dust jacket mentions a section on Amphioxus, but there is no trace of this in the text; perhaps it has been eliminated from the second edition. In general, the book is good without being outstanding; perhaps, in view of the author's definitely stated purpose in the Preface, he did not mean it to be so.

One very good feature is the large number of original illustrations. This is a refreshing change from the usual text-book practice of borrowing illustrations from other authors, with the consequent risk of borrowing their mistakes as well.

A. N. Colefax.

Entomology

The Siphonaptera of Canada. By G. P. Holland. (Canada: Department of Agriculture, Division of Entomology, Publication 817, Tech. Bulletin 70, 1949. 306 pp., 350 text-figs. in 42 plates; 44 maps. 6½" × 9¾".) Obtainable from the King's Printer and Controller of Stationery, Ottawa.

This comprehensive publication contains all that is known about fleas in Canada. The authors presents his data in every possible way which makes for easy reference from all important angles, identification, host relationships, and species distribution. Such contributions to the study of fauna on a regional basis are always welcome additions to biological science both within and outside the country of origin. The special efforts required from both authors and sponsoring bodies should be fully recognized.

David J. Lee.

Mathematics

Methods of Mathematical Physics. By Harold Jeffreys and Bertha Swirles Jeffreys. Second edition. (Cambridge: University Press, 1950. 708 pp. 7" × 10¼".) English price, £4. 4*s*.

The first edition of this important work by Professor and Mrs. Harold Jeffreys was reviewed in This Journal, 9, 222 (1947). In spite of the speed with which the second edition has followed the first, the authors have made a number of significant changes.

The treatment of relaxation methods has been extended to the point of providing an adequate introduction to special works on the subject. The chapter on multiple integrals has been almost completely re-written, and important changes have been made in the chapters on Functions of a Complex Variable and on Contour Integration and Bromwich's Integral. A section on block matrices has been added to the chapter on Matrices. In a number of places, proofs have been shortened or generalized.

The earlier edition of this work has been referred to by one reviewer as containing 'what every young man should know'.

K. E. Bullen.

Nuclear Science

ELEMENTARY PILE THEORY. By Harry Soodak and Edward C. Campbell. (New York: John Wiley, 1950. 71 pp., 21 text-figs. 5½" × 8½".) Price, $2.50.

In the small compass of seventy-one pages the book gives some account of the life history of fast fission neutrons as related to the operation of homogeneous nuclear reactors. The first quarter of the volume is devoted to a preliminary résumé of the slowing down of neutrons, the second quarter to an exposition of diffusion theory; the results obtained being then applied to the chain reacting pile in the remaining half of the volume. The use of reflectors and the importance of delayed neutrons in the control of reactors are discussed.

While for the most part this is an easily digested book, in which an adequate descriptive treatment generally accompanies the mathematical development, there are a few passages where less cursory explanatory remarks would enhance the value of the work to the wider range of scientists and engineers who have some interest in nuclear reactors.

The reviewer feels that the major shortcoming of this useful, if slender, volume is to be found not in its contents but in its price. The cost per page at the Australian retail price is just double that paid on the average for a number of British and American text-books in recent months.

J. C. BOWER.

Phenomena

PHENOMENA, ATOMS AND MOLECULES. By Irving Langmuir. (New York: Philosophical Library, 1950. 436 pp., 43 text-figs., 55 tables. 6" × 9¼".) Price, $10.00.

After forty years of scientific work in which he has published more than two hundred papers, Langmuir has produced his first book. Its title might lead one to expect that Langmuir has attempted an integration of his scientific experience. Instead, one finds reprinted a selection of 20 of his papers and lectures covering a range of subjects almost as wide as his interests and with but a short introduction to give the publication some coherence.

Several of the papers are already well known. He places first 'Science, Common Sense and Decency', originally published in *Science* in 1943. Many will remember his definitions of 'convergent' and 'divergent' phenomena, the predictable and the unpredictable, and his timely warning that the frequent occurrence of the latter in human affairs may impose a severe limitation to the social sciences. It is interesting to read in his Introduction that he considers that the detailed phenomena of meteorology are determined by probabilities and are not subject to the definite relation of cause and effect.

The second and third papers are concerned with the administration of science in the U.S.A. and the U.S.S.R. Writing in 1945, Langmuir criticized the tendency in America to 'put into our democracy some of the worst features of communism—while in Russia they are frankly incorporating the best features of our capitalist system'. In particular he referred to incentives. His optimistic view of the future of science in the U.S.S.R. is modified in the Introduction. He quotes the Lysenko case as an indication that, following the advent of the atom bomb, the attitude of the Russian Government to science has hardened and that in future scientists will be more subject to political control and encouraged less in purely fundamental work.

Langmuir's scientific work as represented by the remaining chapters gives us a picture of the scientist. His main incentive, and unquenchable curiosity concerning physical phenomena, is well brought out in a chapter which tells the fascinating story of his early work at the G.E.C. laboratory. In several of the papers we see him as a careful and observant experimenter. In his theoretical papers we see the directness and vigour of his argument. Much that was speculative when written up to thirty-five years ago is stimulating when read today. But perhaps the most interesting of his characteristics, remarkable in one who has contributed so much on the fundamental level, is his ability to recognize practical applications of his discoveries and to play an important part in applying them. The studies of gas reactions at low pressures, the experimental and theoretical work on the adsorption of gases on solids, the discovery of atomic hydrogen, the studies of insoluble films on water surfaces, are among the works of Langmuir the scientist. The inventor Langmuir has given us the gas-filled lamp and the hydrogen arc.

The subjects which are covered in this volume are many and varied. Few will be interested in all of them, but many will welcome an opportunity to dip here and there. Although it contains no material printed for the first time, the book adds to the stature of the author in so far as it illustrates the breadth of his interests and the bulk and quality of his scientific achievement. Any doubt on this score is allayed by the classified list of his publications which appears at the end of the volume.

The volume suffers from several blemishes in its production. There is evidence of careless proof-reading: the page headings on one chapter are persistently mis-spelt, one diagram and two equations are printed upside down. The format is unimpressive and the paper poorer than one would expect in a book priced at ten dollars.

W. E. EWERS.

Philosophy of Science

SCIENTIFIC AUTOBIOGRAPHY AND OTHER PAPERS. By Max Planck. Translated from German by Frank Gaynor. (New York: Philosophical Library, 1949. 192 pp., 1 photo. 5″ × 8″.) Price, $3.75.

This translation of Planck's scientific autobiography includes the memorial address by Max v. Laue delivered on 7 October 1947 at Planck's funeral in Göttingen. Laue gives a very short sketch of Planck's long and eventful life, of the wide recognition his work has eventually found, and of his pupils' great affection for and gratitude to him.

Quite apart from the general cultural and the specially historical interest of this biography, it is important as first-hand information about the motives that induced Planck to choose theoretical physics as a subject of study at a time when this was quite unusual, and when it was not even a university subject. The causes of scientific progress form a much-debated topic today, and an authentic account of the factual development of a great scientist's ideas leading to indisputable advance in science are an invaluable source of information. Planck's main goal in physics, the search for universally valid laws of nature, is in accordance with his whole philosophy. In this autobiography, as well as in all other publications on the philosophy of science, he emphasized that this was his aim, and that he presupposed the existence of the 'external world' as of 'something independent of ourselves, something absolute'. That he looked for the laws holding for this absolute, leaves no doubt that his physics and his philosophy were based on Kantian ideas, partly—it is true—as seen by Helmholtz.

Planck's interest was first centred round the first law of thermodynamics, for the very reason that he saw in this law 'absolute validity independent of man'. He explicitly stressed that this search for the absolute should not be misinterpreted as preventing him from full agreement with, and appreciation of, the theory of relativity, whose great importance he was one of the first to recognize. Proceeding to the strict definition of 'natural' processes (today they are called 'irreversible') he carried out investigations on the *Entropy* which provided the basis for his thesis (for the degree of D.Phil.). As we now know, they led to fundamental results; but at that time there was no recognition for the young physicist: Kirchhoff rebuked the paper, and Helmholtz did not even read it. Yet Planck continued his studies of the entropy in spite of all disappointing experiences. This was not the only time that Planck's ideas were not readily accepted by his fellow physicists, for whom he, the theoretician, was a type *sui generis* and more or less superfluous. He remarked that he could never find general recognition for new scientific findings, even when he had perfectly conclusive proofs for them, as long as these proofs were only theoretical ones. You do not convince your opponents; they have to die out gradually, and the next generation will be familiar with the new ideas, as they have grown up with them.

How Planck arrived at his epoch-making discovery and how he formulated the radiation law is told with special emphasis on the starting point, when he undertook to derive all properties of the spectrum of heat radiation from the temperature *only*. He was interested in, and attracted by, the universality of this radiation. The radiation law, enunciated on 19 October 1900, was arrived at only by a 'semi-empirical' approach. The *theoretically* deduced formula was presented at the historical meeting of the Deutsche Physikalische Gesellschaft on 14 December 1900. Planck tells of these so revolutionary results in the unassuming, clear, and simple way which we liked so much in his lectures, and which characterizes all his writings. Reading his autobiography hardly anyone would suspect that his discovery of the atomistic structure of energy, governed by the universal constant h, became the basis of all research in physics in our century.

After referring to his frequently stimulating correspondence with fellow scientists, Planck devoted an all too brief passage to his activities in the borderland of physics and philosophy; but there is compensation for this—the four essays which form the last part of this volume give at least a general idea of Planck's philosophy of science. These papers—1. Phantom Problems in Science; 2. The Meaning and Limits of Exact Science; 3. The Concept of Causality in Physics; 4. Religion and Natural Science—though partly well known, may be read and re-read with pleasure and to the greatest advantage of those interested in the philosophy of science.

The translation is very free, though on the whole quite satisfactory where matters concerning physics are treated. Where philosophical terms or expressions covering personal experiences are used, however, the meaning of the English does not always correspond to the meaning of the German original. Nevertheless, these imperfections should not prevent anyone from reading a most interesting and valuable book.

ILSE ROSENTHAL-SCHNEIDER.

Physics

THE CHARACTERISTICS OF ELECTRICAL DISCHARGES IN MAGNETIC FIELDS. Edited by A. Guthrie and K. R. Wakerling. National Nuclear Energy Series, Division 1, Volume 5. (New York: McGraw-Hill, 1949. 376 pp., numerous text-figs. and tables. 6″ × 9¼″.) Price, $3.50.

This volume is part of the series, in the course of publication, which constitutes a record of the research work carried out during the last world war under the Manhattan Project

and the Atomic Energy Commission of the United States.

It summarizes the researches made in the Radiation Laboratory of the University of California, under the direction of the Australian physicist Professor H. S. W. Massey, for the purpose of improving the operation of the electromagnetic separation plant at Oak Ridge. Over half of the book is devoted to the work of members of a British team (which included another Australian, E. H. S. Burhop).

In Chapter 1, D. Bohm gives a qualitative description of the arc plasma in a magnetic field. The conclusion of greatest interest which is mentioned is that random perturbations of the medium are constantly occurring. The author states that:

> In an unpublished study of the dynamic behaviour of plasma in a magnetic field it was found that any system of plasma flow that is directed, . . . is unstable. If, for example, a small plasma oscillation should get started by chance, it has been shown that it will grow in amplitude with time.

It may be added that no reference whatever is made to very similar theoretical conclusions which were published in *Nature** some fourteen months before this book appeared.

In Chapter 2, Bohm, Burhop and Massey discuss the use of probes for studying a plasma in a strong magnetic field. The principal conclusion at which they arrive is that the ordinary Langmuir theory is inapplicable and that the electron currents to a probe in a strong magnetic field depend largely on a process of diffusion which depends on the plasma oscillations present; this is styled 'drain-diffusion'.

Chapters 4 and 5 are concerned respectively with theoretical and experimental investigations of the minimum pressure required for stable operation of an arc; Chapters 6 and 7 are devoted to experimental studies of the ionization and dissociation by electrons of uranium tetrachloride and uranium hexafluoride.

The very long Chapter 9 contains an extensive study of the arc plasma by Bohm, Burhop, Massey and Williams. This includes a good deal of information on the electrical fluctuations observed by means of a cathode-ray oscillograph over frequencies ranging from some hundred to one million cycles per second.

In Chapter 10, W. E. Parkins discusses experimental arrangements for ionizing a vapour by means of electrons produced elsewhere in a gas discharge. The concluding Chapter 11, by J. Backus, is concerned with studies of discharges in a Philips Ionization Gauge, undertaken for the purpose of examining the electrical fluctuations in an arc. These fluctuations are termed 'harsh' throughout the book, and presumably are the same as those called 'noise' by other writers.

The book as a whole constitutes a valuable contribution to the subject of electrical discharges in magnetic fields, and its appearance is particularly welcome to those physicists in Australia who are engaged in researches in the same field.

V. A. BAILEY.

* For 17 April 1948 (p. 599), under the title 'Spontaneous Waves in Discharge Tubes and in the Solar Atmosphere'.

Zoology

SELECTED INVERTEBRATE TYPES. Edited by F. A. Brown, Jnr. (New York: John Wiley; London: Chapman and Hall, 1950. 597 pp., 235 text-figs.) Price, $6.00.

This somewhat expensive book deals with over 120 types and is the work of thirteen different American contributors. It is a sound piece of work and the authors have been at pains to obtain the most up-to-date information on almost all of their types. The list of references alone will be of real value to zoological teachers and covers a range of reading greater than most individuals can have covered. In addition to this work of scholarship, the writers give the impression of really knowing their animals. Their comments upon habitats, distribution, abundance, locomotion and behaviour show that their interests extend beyond laboratory walls and also that they are interested in animals as well as corpses.

Different contributors have handled different sections, and the standard of merit varies from excellent to average. Generic names are altered punctiliously for a while, and then one finds *Eolis* unaltered from the 1850's. Illustrations are excellent, but their abundance varies from 60 figures in the first 84 pages to 22 pages of unleavened text on *Xiphosura*. The selection of types and allocation of space to different phyla is also open to criticism. Protozoa to Annelids cover half the book (309 pages), while Molluscs have only 42 sketchy pages. Amongst 34 Protozoan types one might have expected at least one Foraminiferan and one Radiolarian to be mentioned. Proportional representation must have been alarmingly disregarded when eight Holotrichous ciliates were included, as against only two representatives of the insects, and one of these, moreover, only in the larval form.

In spite of these faults the book is an extremely good one and provides information not available elsewhere between two covers. Every invertebrate zoologist within a university ought to read this book, whether he be lecturer, demonstrator, or serious student, and whether he be anatomically or physiologically minded.

W. STEPHENSON.

The Australian Journal of Science

Vol. 13 21 December 1950 No. 3

Medical Research

With Special Reference to the John Curtin School of Medical Research in the Australian National University*

Sir Howard Florey†

I. Historical

Perhaps it may provoke useful discussion if we examine the way in which knowledge of disease and of the normal working of the body has been acquired in the past, and if we enquire whether modern technical developments have modified the methods of training research workers who are in various ways going to investigate disease. This may lead to an assessment of the requirements in persons and equipment both for conducting researches on sick men in the wards of hospitals and for fundamental researches in the laboratory.

The first knowledge of pathological aberrations in man was acquired in antiquity by observation on the sick. Though this was apparently carried out with considerable skill by ancient people such as the Egyptians and the inhabitants of Mesopotamia, some of whose records survive, it is the Greeks who are held up to us as the originators of all that was best in ancient medicine, and whose influence on Arabic and western medicine was paramount for 1500 years. Even today we retain many terms introduced by them and the Hippocratic oath still represents to many medical men the highest ideals of medical service. The detailed contributions of the Greeks have been discussed many times by many authors and Osler has summed up their literature as follows: 'If asked what was the great contribution to medicine of Hippocrates and his school we could answer—the art of careful observation'.

It should not, however, be thought that experiments were not performed in antiquity. Galen, for example, demonstrated the function of the laryngeal nerves, the motor and sensory functions of the spinal nerve roots, and the effect of hemisection and transverse section of the spinal cord. Nevertheless, in spite of such striking examples to the contrary, experimental biological science did not become established in antiquity, nor was human anatomy very exactly known; as the Greeks did not, except apparently for a short time in Alexandria, examine the human body. In such circumstances the ingenious physiological and pathological theories connected with the humours and the spirits were unchecked by any experiments to test their truth. In the course of time the views of Galen and other ancient writers were elaborated into a dogma, which was not seriously questioned until the fifteenth century, when modern anatomical knowledge founded on careful dissection of man's body was first firmly established by Vesalius and his successors. On the work of the anatomists was founded the epoch-making work of Harvey about which Osler commented: 'The *De Motu Cordis* constitutes a unique piece of work in the history of medicine. Nothing of the same type had appeared before. It is a thoroughly sensible, scientific study of a definite problem, the solution of which was arrived at through the combination of accurate observation and ingenious experiment'. Harvey, in fact, 'gave us a way of arriving at physiological truth, namely, the testing of hypotheses deduced from the study of structure in experiments on living animals' (Franklin).

From the seventeenth century onward, experimental procedures for the investigation of natural phenomena became of increasing importance, not only for sciences closely allied to medicine, but particularly for physics and chemistry. It is interesting to note, however, that Roger Bacon, who lived and worked in Oxford, had already in the thirteenth century a clear grasp of what the experimental method

* A lecture delivered in the University of Melbourne on 9 August 1950.

† Professor of Pathology in the University of Oxford; member of the Academic Advisory Committee of the Australian National University and Adviser to the University on the development of the John Curtin School of Medical Research.

meant to science. He said: 'Experimental science has three great prerogatives over other sciences: it verifies conclusions by direct experiment; it discovers truth which they never otherwise would reach; it investigates the course of nature and opens to us a knowledge of the past and of the future'. Unfortunately, he was much before his time and his views had little, if any, immediate effect.

Pathological Anatomy

At the same time as experimental methods became increasingly important, pathological anatomy began to make its great contribution to the study of disease. At first, knowledge of structural changes associated with disease was obtained incidentally to the study of the normal by the anatomists. The first person to undertake *post mortem* examinations with the specific object of finding out the cause of death was Benivieni, a Florentine surgeon who lived from about 1440 to 1502, but it is Morgagni (1682-1770) who is credited with initiating the scientific study of gross morbid anatomy. He made a vast number of *post mortem* morbid anatomical observations which were closely correlated with findings on the subjects while still alive. His great book consists of a series of letters to a friend whose name is now unknown, but who stimulated the writing of the letters which cover some 700 cases and *post mortem* reports.

'The first systematic text on pathological anatomy in any language' (Krumbhaar) was published by Matthew Baillie (1761-1823), and the end of the eighteenth century saw the introduction by Bichat of the conception that diseases occur in tissues—such as blood vessels, muscle, bone, and so on. The high-water mark of descriptive morbid anatomy was reached in the nineteenth century with Rokitansky (1804-1878), who is stated to have performed 30,000 autopsies himself, and to have had access to material from 60,000.

The correlation of *post mortem* observations with the pathological physiology of the sick patient made great progress possible in diagnosis and treatment of disease, though it is interesting to note that so great a physician as Sydenham (1624-1689) scoffed at the value of *post mortem* examinations.

Pathological Experiment

Though the physiologists of the seventeenth and eighteenth centuries made many fundamental discoveries on the working of the normal body by the use of the experimental method, the first definite application of experiments to the solution of pathological problems was made by John Hunter, who was followed by many others in the nineteenth century—the greatest of them probably being Cohnheim. The ever-expanding knowledge of the conditions present in, and the changes caused by, disease was greatly influenced by the introduction of instruments of precision. Of these, the microscope was undoubtedly the most important, though it is curious now to note how long a time elapsed before it was used for the specific purpose of investigating diseased tissues and disease processes. For example, Bichat produced his views on tissues without the aid of the microscope, though he did employ a few chemicals to aid in manipulation. Though the microscope had been used with great effect by Leeuwenhoek, Hooke, Grew, and others in the seventeenth century, it was not until well into the nineteenth century that the new world of the tissue cells of animals was opened up when Schleiden (1804-1881) and Schwann (1810-1882) first clearly enunciated the cell theory in 1838 and 1839.

As so much of the progress in medicine in the nineteenth century depended on the microscope, it may be interesting to recall the fact, not often remembered, that Lord Lister's father, J. J. Lister, who was a wine merchant, read a very important paper in 1830 on improvements in the achromatic lenses of the compound microscope, an instrument that was further developed during the rest of the century which also saw much improvement in various other types of physical, chemical, and biological apparatus. In this instrumental milieu Virchow gave great impetus to the study of disease by removing the proposed seat of disease from the tissues, as proposed by Bichat, to the constituent cells of tissues. This line of thought is pursued at the present time with ever-increasing refinement of tissues. The introduction of instruments also widened the scope of clinical diagnosis; for example, that made possible by the introduction of the stethoscope by Laenned, and by the use of the clinical thermometer and temperature registration. The nineteenth

century witnessed advances both in fundamental discoveries and in the performance of the doctor at the bedside, and gradually the great dependence of the practice of medicine and surgery on laboratory discoveries became more widely recognized.

Perhaps the most clear-cut example in the nineteenth century of the effect of discoveries in the laboratory on the practice of medicine and surgery is furnished by the history of antiseptic surgery. It is of great significance that Lister was not a surgeon who simply diagnosed his patients' ailments and operated on them if he thought it appropriate. He thought profoundly of the processes at work, and while still a young man became interested in experimental pathology, to which he added a number of original observations. We have, for example, an illustration in two colours made by Lister of his observations on the blood flow during inflammation in the frog's web, which he studied because he wanted to know more about inflammation. Lister, with his experimental background combined with that obtained from his more strictly surgical activities, grasped the importance of Pasteur's observations on fermentation, and was able to link putrefaction in wounds with bacterial infections. The consequences of this need no emphasis. Pasteur was a chemist who was led to the study of biological phenomena and eventually into the therapeutic field of medicine.

Team Research

There are, of course, innumerable examples of the way in which observations on disease are made first in the clinic, and further elucidation obtained by experiment. Many would, indeed, claim that this is how all medical research proceeds. Osler mentioned in this connexion the work done on the function of the thyroid gland: 'Part of its special interest is due to the fact that clinicians, surgeons, experimental physiologists, pathologists and chemists have all combined in splendid team-work to win the victory. No such miracles have ever been wrought by physicians as those which we see in connexion with the internal secretion of the thyroid gland.' He had particularly in mind the turning of an imbecile cretin into a worthy citizen.

One of the most important generalizations that can be made from the work of the nineteenth century and the beginning of this century is that rapid progress in the elucidation of disease processes can usually be made when such processes are reproducible in animals and thus become susceptible to detailed analysis. Another factor of increasing importance is that most investigation is now done by the collaboration of a number of workers; for the twentieth century has seen the unprecedented expansion of the experimental method in all sciences and not least in the biological sciences, and it is now impossible for one man to be a master in all. Perhaps the most striking recent development has been the emergence of biochemistry and biophysics to be subjects of study of the utmost importance to medicine. Those who follow these disciplines are probing ever more deeply into the intimate mechanisms of processes within cells by which they live and multiply. Discoveries in these fields sooner or later influence practical medicine and many recent therapeutic procedures owe their origin to biochemical studies.

Research Apparatus

Many advances in medical sciences are due to the elaboration of apparatus of great precision. Protein chemistry, for example, has been revolutionized by the invention of such machines as the ultracentrifuge, of electrophoresis apparatus, and of partition chromatography and its variants. These machines and techniques have enabled us to acquire much new information about cellular behaviour, and to form clearer ideas of the actual structure of living units. Even microscopy, a technique which appeared to have reached its limits, has been rejuvenated by the recent invention of the electron microscope, which has helped to clarify our ideas on the structure and behaviour of (among other things) the so-called ultramicroscopic viruses; and by the reflecting microscope, by means of which ultra-violet and infra-red absorption spectra of even single cells may be determined. By such means the horizons of experimental research are ever widening.

Improvement in diagnosis of the causes of illness in sick people, that had been steadily made over the centuries by correlation of manifestations in the living with appearances after death, has in the last fifty years or so been accelerated by the employment of various

physical and chemical procedures that have been contributed from the laboratory—such as, for example, the use of X-rays, electro-cardiograph, encephalography—and by the host of tests and examinations now performed as a routine in clinical, pathological and biochemical departments. It is difficult to think of any new diagnostic procedure which is not founded on experimental work done either in laboratories having something to do with the biological sciences or in those devoted to physics or chemistry.

Drugs

The influence of laboratory researches on the practice of medicine can be clearly seen if we consider therapeutic advances associated with drugs. When I was a medical student there were few drugs that did anything significant to cure disease; though there were some which were of use, such as morphia, cocaine, quinine, and other alkaloids, the vermifuges, emetine, digitalis, and arsenic compounds. Ether and chloroform were the only anæsthetics used except for the occasional administration of nitrous oxide with oxygen. Nevertheless, there were plenty of substances in the pharmacopoeia, and I remember that in the examination in Materia Medica we were asked to identify some horrible little bits of dried plants.

Today the physician has been furnished with a dazzling array of powerful therapeutic substances—the hormones, the vitamins, the antibacterial drugs, new anaesthetics for intravenous use, drugs for treating allergic manifestations and so on. Pharmacology and experimental therapeutics have become branches of study of fundamental importance for the practice of medicine. In fact, the most striking change in medicine in the last twenty-five years is the great increase in the use of drugs that are really effective in a number of serious diseases.

Medical Science

Now, although it is the physician and surgeon, and perhaps the patient, who sees the last and often the most striking stages of the work on therapeutics, they are to a large extent applying work which has previously been done in laboratories. When you next take a drug from a bottle (or see it being taken if you are a patient) it might be profitable to ponder on who has put it into the hands of the medical profession. 'They' are chemists, pharmacologists, bacteriologists, fermentation engineers and chemical engineers, and lastly, clinical observers who have, or should have, some knowledge of experimental procedures. Most of these investigators have no medical qualifications, and the work—except for that of the clinical observers, which comes late in the investigation—is almost always carried out in laboratories having no close connexion with hospitals. I bring out this point because I understand that a number of medical people consider that the new research Medical School of the National University will be severely handicapped, or even practically valueless, because it is not attached to a hospital. I do not share this view because, as I have endeavoured to indicate, much modern fundamental medical research is not done in close association either with hospitals or with patients.

It is interesting to note that a considerable proportion (probably at least half) of the research workers at the new laboratories of the Medical Research Council at Mill Hill, near London, have no medical qualifications; indeed, the Director is a biochemist without medical qualification. This great institution has no direct connexion with any hospital, but can rely on co-operation from hospitals when required. It is also interesting to observe that the Medical Research Council offers grants to promising young men for training in research methods. Over 80 per cent. of these grants go at present to men with no medical training.

I have, I think, made my views on medical research clear, namely, that from a contemplation of the history of medical science, and from consideration of its present development, the most important thing to encourage is experiment.

Clinical Research

It would, however, be erroneous to suggest that medical research is not done at all in connexion with hospitals, and that for many purposes a close association with the patient is not desirable. It seems fairly clear that there is a diminishing return from simple bedside observation carried out with instruments commonly used by practitioners, and by the

exercise of the intelligence. It would be very rash to say that no discoveries are now likely to be made by this method. One of the best recent examples of a real discovery by these means is to be found in Australia; that is, the remarkable series of observations initiated by Gregg on the relationship of infection by rubella early in pregnancy to the production of congenital abnormalities. This work, which has been ably followed up by Swann and others, was the result of good observation in the clinic and intelligent correlation of these observations with vital statistics. Perhaps a similar type of discovery is being made at present in the apparent association of inoculation, or perhaps of any trauma, with the development of manifestations of poliomyelitis in the traumatized part. Of the same type is the observation of the effect of an attack of epidemic jaundice on the lesions of rheumatoid arthritis. By roundabout means which we cannot follow now, this has led to the discovery that cortisone has some remarkable effects in rheumatoid arthritis and other diseases.

It is clear that clinical observation with the simplest means can result in discovery, but that is rather a different matter from saying that many practitioners of medicine or surgery are going to make them. I remember that when I was a medical student McKenzie's work on diseases of the heart was held up as an example of what a practitioner could accomplish in the ordinary course of his duties, and the suggestion was that everyone could do this if they tried. McKenzie happened to be a very intelligent man and he used what is virtually a physiological technique to study his cardiac patients. He was, in fact, an experimentalist. I think that anyone who does experiments with skill will discover something, however trivial, but I am sometimes disconcerted to hear people suggest that because what they call 'plenty of material' is available in a hospital it is only necessary to hire someone—usually at a small salary—to make significant discoveries.

One form of activity, however, by which many practitioners contribute to the advancement of medicine, is the description of the peculiarities of the manifestations of disease in single cases, or in a series of cases, or of the results of treatment. Medical journals are full of papers of such a nature. From data accumulated in many places in this way generalizations of value can sometimes be made, and, over a number of years useful knowledge, improvements in diagnosis, treatment and prognosis accrue. This is the type of work that is done in most large hospitals with active medical staffs, and its value, in the aggregate, is considerable. It is not, however, 'research': for serious and sustained research requires the definition of a problem which is then pursued by all appropriate means—a conception which is now held by all those devoting their main energies to clinical research.

The advance in the understanding of anaemias during the last twenty-five years or so affords an instance of clinical research conducted on patients and in laboratories attached to hospitals. The original stimulus was given by the observations on the effect of liver on pernicious anaemia that were first made by Minot and Murphy, though their work was, in fact, a continuation of Whipple's observations on the effect of eating liver on blood regeneration following haemorrhage in the dog. The spectacular results obtained led to a closer examination of all forms of anaemia. The investigation of the anaemias, which has greatly extended, depended in the first place on observations in the haematological laboratories of hospitals of blood and bone marrow and by the use of man for experimental purposes. Observations on pernicious anaemia were made in the first instance on patients in a hospital and in the associated laboratories by relatively simple means; but the study of the anaemias opened up many interesting biochemical and chemical problems, which are now for the most part being investigated in laboratories not directly attached to hospitals. The study of the anaemias presents a first-class example of the application of observation and experimental methods for the elucidation of specific problems.

Surgery and Research

Good illustrations of the importance of the experimental outlook can also be had from surgery. Any surgeon who elaborates a new operative technique should be, and often is, an experimental physiologist and pathologist, for much of his success will often depend on his knowledge of physiology and whether he tackles his problems in the way a physiologist does. In short, most of the real surgical innovators have an experimental background and outlook.

Harvey Cushing, besides his great contributions to neuro-surgical technique, contributed discoveries to physiology. The work of Blalock, Professor of Surgery at Johns Hopkins, on experimentally induced surgical shock in animals, forced a reconsideration of the ideas on shock left by the first world war. On his experimental work much of the successful treatment of shock in the last war depended. He it was who made observations on the relationship between *myasthenia gravis* and the thymus, and more recently he has elaborated operations designed to relieve the anatomical defects of certain cases of congenital cyanosis due to abnormalities of the heart and large blood vessels, and has taught his methods to others. He is, in fact, a skilful operator but at the same time a physiologist.

Conclusion

The history of the development of medical science demonstrates the increasingly great contributions that those who work in the laboratory, or have been trained in laboratory methods, have made, not only to the understanding of the intimate working of the body in health and disease, but also to the practical day-to-day activities of physicians and surgeons. The great needs of the present time, in Australia as elsewhere, are therefore to provide first-class facilities for the conduct of at least the main types of laboratory research in medical sciences and in sciences closely related to them, and to give facilities for those aspiring to undertake serious and continuous clinical research to obtain a grounding in research discipline which can be learnt best in the laboratory. As a corollary to this, clinical research workers must have their own laboratories as well as their hospital beds if they are, in these days, to do good and fruitful work.

(Part II of this article will deal with the John Curtin School of Medical Research.)

The Rutherford Memorial

P. I. Dee

The discovery of X-rays by Röntgen in 1895 is often cited as the starting point of a new scientific era. An event of equal significance to science in that same year was the arrival in Cambridge from New Zealand of Ernest Rutherford, then aged twenty-four, just in time to be registered as the first research student at the Cavendish Laboratory under a new statute which allowed graduates of other universities to become eligible for a higher degree after two years work at research. Within a year, Rutherford, following up work which he had done in New Zealand, developed a magnetic detector which made it possible to receive wireless signals over a distance of half a mile. It is fortunate, however, for science that, during the following two years, discoveries were made in other fields which deflected the interests of Rutherford from the developments of wireless communication to a subject of infinitely greater generality and importance.

In order to form a background for the assessment of Rutherford's work and also to appreciate the effect of these discoveries upon the mind of the young researcher, it is necessary to consider the state of science in these concluding years of the nineteenth century. The great developments of the atomic theory, stimulated by the growth of chemical industry, seemed to provide a final scientific description of the laws of chemistry and of the nature of matter. The brilliant success of the application of the Newtonian scheme in the kinetic theory of gases was a further triumph for atomism and apparently justified the expectation that all the physical phenomena relating to matter, like those of chemistry, merely awaited a routine application of the same principles. Fundamental in this outlook was the belief that the material atoms were eternal and indestructible. The work of Joule upon the quantitative equivalence of heat and energy had similarly established the constancy of available energy. The wave theory of light extended by the work of Faraday and Maxwell had marked the beginning of field physics, and although the situation here was less clear, only few could have doubted that a complete unification of physical science would accrue from the application of the Newtonian concepts to atoms and to some form of luminiferous ether.

Within thirty years most of these tenets had been abandoned. The facts of radioactivity had not only established the impermanence of atoms, but also had been brought within one comprehensive scheme which showed in detail the nature of the transformations which such atoms undergo. Atoms, previously definable in terms only of mass, had been shown to have a complex structure in terms of which their properties received a comprehensive description. The possibility of effecting atomic transmutations under human control had been experimentally established, the vast store of energy available within the atomic nucleus revealed, and the foundations laid for its exploitation. Rutherford himself was not only responsible for

the brilliant conception of the key experiments which established each of these discoveries, but was also directly responsible for their execution.

A similar revolution in outlook has also occurred during the present century in regard to field physics, namely, in the development of quantum and wave mechanics and of the theory of relativity. The replacement of Newtonian mechanics by quantum mechanics followed directly upon the successful attempt by Bohr to account for the emission of light by atoms by applying Planck's quantum of action to the Rutherford planetary atomic model. Einstein's theory of relativity receives its most convincing experimental verification in the quantitative equivalence of matter and energy as revealed by experiments upon artificial transmutation of matter. Rutherford's work, therefore, may be regarded as catalytic over the whole great range of modern physics; but his supreme contribution lies undoubtedly in his brilliant exposition of the most ultimate structure of matter.

Having thus sketched the broad outlines of Rutherford's contribution to modern physics, it is interesting to review in slightly more detail the dominant phases of his work, since this will make it possible to give a few chosen examples which illustrate his great genius as an experimenter and his wholly exceptional scientific insight.

Rutherford's work falls into three main phases: the first at Montreal, the second at Manchester, and the third at Cambridge. In 1898, after only three years of research as a student at Cambridge, Rutherford was appointed professor of physics at Montreal at the early age of twenty-seven. In a letter to his mother he said, 'I know you will be pleased to hear that I have got the Montreal post and so start up in life as a Professor with £500 a year . . . and an unlimited prospect of work'. It is easy now to envisage this unlimited prospect of work. During his previous two years at Cambridge, Rutherford had worked under the direction of J. J. Thomson on the celebrated investigations relating to the conduction of electricity through gases, which later resulted in Thomson's discovery of the electron. Shortly after Becquerel's discovery of the blackening of photographic plates by salts of uranium, it was shown that these salts had also the property of making gases conductors of electricity. Rutherford had already investigated some of the properties of these supposed radiations from uranium and thorium compounds. The problem was one of incredible difficulty and complexity. A large number of distinct, and, at that time, unrecognized phenomena were involved in the experiments. Thus, two types of radiation, the α- and β-rays, were emitted from these substances. The rate of emission of the radiation from each substance decayed according to an exponential law. The process of radioactive decay gave rise to new substances which were also radioactive and which decayed at different rates; in some cases these product substances were gases which, under the influence of draughts, gave rise to wildly inconsistent results. Furthermore, the radioactive decay of these gaseous emanations formed radioactive deposits upon parts of the apparatus, giving thereby the possibility of further inconsistencies. One saving feature of the phenomena was the fact that in some cases bodies with different radioactive properties possessed different chemical behaviour. By a series of investigations, brilliant both in conception and execution, Rutherford and Soddy, within three years, laid down the basic principles underlying these phenomena and put forward, with incontrovertible evidence, their theory of 'radioactive change' . . . 'Radioactive change, therefore, must be of such a kind as to involve one system only . . . the changing system must be the chemical atom . . . in radioactive change the chemical atom must suffer disintegration.'

This great work, which not only destroyed the concept of the permanence of atoms, but also made clear the laws according to which certain atoms are transformed spontaneously from one species to another, formed the dominant theme of Rutherford's work during the Montreal period. By 1904, the general principles had been applied with great skill to the successive decay products of the radium family. The nature of the genealogical tree for a connected series of radioactive decay products was put forward in a form which has not since required substantial modification. It is difficult even nowadays to imagine how such a complex range of phenomena could have been separated and systematized in so short a time. Rutherford was destined later to obtain results of even greater importance and generality, but it is probable that this phase of his work represents the most brilliant piece of imaginative experimentation ever performed in the history of physical science.

After nine years at Montreal, Rutherford accepted the Langworthy chair of physics in the University of Manchester. Here, in collaboration with Geiger, then a young assistant, techniques were developed for the detection of individual atomic particles. This was to have a far-reaching effect upon future work. In experiments using these techniques upon the scattering of the α-particles from radioactive substances by very thin metallic foils, it was observed that on very rare occasions some of the α-particles were scattered through large angles. Rutherford's grasp of the fundamentals of his subject, combined with his great imaginative insight, stimulated him to pursue this trivial clue which so many would have neglected. He found it possible to reconcile the observations only with a concept of the atom as possessing a massive minute nucleus. The law of scattering which followed mathematically

from this assumption was worked out, and, within a few months, accurate new experimental results were available which confirmed the hypothesis in minute detail. The planetary model of the atom was in this way first established. The subsequent application of quantum mechanical principles by Bohr to the Rutherford atom model gave a comprehensive description of the optical spectra of the elements. Moseley's brilliant investigations on the X-ray spectra of the elements gave rise to the concept of atomic number and systematized the applicability of Rutherford's atom model to the whole range of natural elements.

Lagrange once said that Newton was not only the greatest genius who ever lived, but also the most fortunate, 'for there is but one universe, and it can happen to but one man in the world's history to be the interpreter of its laws'. Rutherford's achievement in revealing the character of the infinitely small atomic world, and the far-reaching consequences of this and his other work upon all fields of physical science, must surely give him place with Newton as the greatest physicists of all time.

Despite serious interruption of his scientific work by the first world war, Rutherford had, by 1919, published the results of yet another epoch-making discovery. Following upon his discovery of the atomic nucleus, Rutherford made experiments to probe the nature of this minute nucleus by bombarding matter with the α-rays from radioactive substances. In such experiments he showed conclusively that when nitrogen was bombarded with α-rays there occurred a rare but definite emission of fast hydrogen nuclei. This was the first occasion upon which controlled transmutation of matter was successfully accomplished. Shortly after this discovery, Rutherford succeeded Sir J. J. Thomson as Cavendish professor of experimental physics at Cambridge, and it was in the Cavendish Laboratory that the main part of this third great phase of his work was carried out. In collaboration with Chadwick, the earlier experiments were repeated and extended to many other elements. Convincing proof was given that atomic transmutation could, in fact, be effected by these means. During the subsequent decade a multitude of other experiments, which, by normal standards, would rank as highly important, were carried out by Rutherford and his collaborators.

The final climax of this work came, however, in the year 1932, following a period of intense progress in techniques. In that year, Chadwick, working at the Cavendish Laboratory, discovered the neutron, and Cockcroft and Walton succeeded in disintegrating the lithium atom by artificially accelerated protons. These two great achievements carried out in Rutherford's laboratory owed much to his direction and encouragement. In his Bakerian Lecture before the Royal Society in 1920 Rutherford had postulated the existence of a neutron and successfully given an uncannily correct prediction of its properties. In this same lecture he concluded, 'The existence of such atoms [neutrons] seems almost necessary to explain the building up of the nuclei of heavy atoms'. Thus, with typical insight, he foreshadowed the present nuclear model in which neutrons and protons constitute the elementary structural units. The experiment which effected the entirely artificial disintegration of lithium by Cockcroft and Walton was carried out at Rutherford's direct instigation. The dream of the alchemists had at last been realized, and although, of course, there were many co-workers in the final stages of this work, it is clear that Rutherford was the outstanding genius responsible for the basic conceptions and also for personally conducting by far the greater part of the experimental work.

Rutherford died in 1937, and therefore did not live to see the great technological developments which have extended this work to macroscopic quantities of matter and made possible the utilization of the vast store of nuclear energy for the benefit of man. If, as we all hope, these possibilities are not frustrated by political error, Rutherford's part in bringing the forces of nature to the useful service of man will surely rank supreme.

During Rutherford's lifetime the problem of atomic structure was completely solved, and the outstanding problem in regard to the constitution of matter now lies in the study of the structure of the nucleus revealed by his experiments. Despite the great amount of work which has been done, this latter problem so far seems to lack entirely the elegant simplicity which the genius of Rutherford made sufficient for the description of the atom. This may, of course, be a fundamental consequence, but those who knew Rutherford well have added cause to regret the absence of his leadership in these momentous years.

At a recent conference on nuclear physics, held at Oxford, Niels Bohr, in the concluding address said: 'This gathering would not be complete without remembering the one who was so loved and respected by each one of us who knew him; the one who not only discovered the nucleus of the atom, but who revealed the transformations which it can undergo, and finally guided the researches which made it possible to effect these transformations under controlled conditions. Out of his work has grown the whole of this great subject of nuclear physics with its far-reaching potentialities.' To a gathering of physicists drawn from all parts of the world, Bohr did not find it necessary even to mention the name of this one man.

The Council of the Royal Society is now taking steps to create a Rutherford Memorial.*

* See below, page 76.

Some Important Dates in the Life of Lord Rutherford

1871—Ernest Rutherford born on 30 August, at Brightwater, near Nelson, New Zealand, the second son and fourth child in a family of twelve. His father, James Rutherford, migrated from Dundee at the age of three, child of a Scots colonist.

1890—While at Nelson College obtained a Scholarship to Christchurch College, Canterbury, part of the University of New Zealand.

1893—Obtained the only First Class Honours M.A. Degree awarded in the University.

1894—Published his first scientific paper in the *Transactions of the New Zealand Institute*, entitled 'Magnetization of iron by high-frequency discharges'.

1895—Was awarded an 1851 Exhibition and came to Cambridge to research in the Cavendish Laboratory under Sir J. J. Thomson. He was the first student to be accepted as an advanced student at Cambridge in work which permitted the granting of research degrees.

1896—Succeeded in transmitting wireless signals over half a mile using a magnetic detector of his own invention. Shortly afterwards he abandoned this work, for research with J. J. Thomson on the discharge of electricity through gases.

1898—Appointed Professor of Physics at McGill University, Montreal. Within a few years, he established the main experimental principles relating to radioactivity, thereby refuting the well-established belief that atoms were permanent and indestructible.

1900—Married Miss Mary Newton, who had been a fellow student in New Zealand.

1903—Elected Fellow of the Royal Society.

1905—Awarded the Rumford Medal by the Royal Society.

1907—Elected Langworthy Professor of Experimental Physics at the University of Manchester.

1909—Awarded the Nobel Prize for Chemistry.

1911—Advanced, with clear experimental confirmatory evidence, the current conception of the atom as a minute planetary system with a massive central 'sun'—the atomic nucleus.

1914—Listed Knight Bachelor in the New Year Honours List.

1914-1918—Transformed his laboratory at Manchester into an acoustics laboratory and studied methods for the underwater detection of submarines. During this period he joined a mission of English and French chemists, engineers and physicists to the United States to survey the use of scientific methods in anti-submarine warfare.

1917—Showed that hydrogen atoms were ejected from nitrogen under bombardment by the α-rays from radium, thereby for the first time establishing the possibility of effecting the disintegration of the atom.

1919—Succeeded Sir J. J. Thomson as Cavendish Professor of Experimental Physics at Cambridge, where, under his guidance, important researches were carried out in all branches of Physics, particularly Nuclear Physics.

1920—In 1920 Rutherford predicted the existence of the neutron, which was subsequently discovered at the Cavendish Laboratory by Chadwick in 1932.

1932—In 1932 Cockcroft and Walton, at Rutherford's direct instigation, disintegrated the lithium atom by bombardment with protons which had been accelerated in a high-voltage discharge tube, thereby effecting, for the first time, the wholly artificial disintegration of the atom.

1925-1930—President of the Royal Society.

1931—Created Baron Rutherford of Nelson and took his seat in the House of Lords.

1937—Rutherford died in 1937, and therefore did not live to see the great technological exploitation which has led to the atomic bomb and to the possibility of making the vast store of atomic energy available to the service of man. Nevertheless, Rutherford must always be regarded as the great genius who laid the whole of the experimental foundations of the structure of the atom and of the nature of radioactivity and discovered the existence of the atomic nucleus. Rutherford's remains were laid to rest in Westminster Abbey, near the grave of Isaac Newton, the only other scientist whose work is comparable in brilliance and comprehensiveness.

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Subdivision of the Adelaide System

DOUGLAS MAWSON* AND REG. C. SPRIGG†

THE recent publication of the proposed Australian Code of Stratigraphical Nomenclature in the *Australian Journal of Science* (Glaessner and others, 1948; Raggatt, 1950) has accentuated the need for standardization of the subdivision and terminology of the Adelaide System. This has become particularly desirable in view of the considerable literature now available dealing with this rock system, and because of the great expansion of geological mapping undertaken by the State Geological Survey and by staff and students of the University of Adelaide.

Howchin's type-area for the System has now been re-mapped completely in considerable detail (Sprigg, 1946) and extensive detailed stratigraphic successions have been measured widely throughout the Flinders Ranges (Mawson, 1938, 1939, 1940, 1941, 1942, 1946 and 1948;

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Sprigg, 1945). A revised subdivision of the major elements of the rock sequence is now considered practicable.

In the authors' opinion, Professor W. R. Browne, in the Geology of the Commonwealth of Australia (David and Browne, 1950), has utilized the extensive literature very ably and has arrived at a subdivision in accord in many ways with the writers' ideas. There are, however, minor divergences of opinion relating to the limits of certain subdivisions based on a more personal knowledge of the field geology of the System.

Browne's term 'Adelaide Geosyncline' is appropriate for the geological setting in which the sediments of the Adelaide System accumulated, but its adoption here emphasizes more than ever the undesirability of retaining Howchin's term 'Adelaidean' for a section of the marine Tertiary succession in the neighbourhood of Adelaide: this latter use of the term is highly confusing to all students of Geology and should be discarded as early as possible.

The original term 'Adelaide Series' suggested by David (1922) and accepted and adopted by Howchin was devised to cover the whole of Howchin's unfossiliferous succession in the neighbourhood of Adelaide above the Aldgate basal sandstone. It thus included the considerable thickness of sediments (Howchin's 'Purple Series') above the Brighton Limestone horizon extending south along the coast to Hallett Cove, a series characterized by more or less of a purple to chocolate colour tone. Later, in 1929, Howchin referred this 'Purple Series' to the Lower Cambrian and limited the 'Adelaide Series' to the underlying succession with the Brighton Limestone as the top member. This, David later adopted.

As investigations since that time have failed to confirm as fossils peculiar markings in these rocks, South Australian geologists have continued to include in the Adelaide Series the whole of the succession up to beds whose age has been established as Cambrian by inclusion therein of undeniable fossils. In recent years, because of the growing appreciation of the extent and thickness of these sediments, and the obviously extended time-range covering their deposition, the term 'System' (Mawson, 1948B) has been applied locally in preference to 'Series'. This, we are glad to note, has been adopted independently by David and Browne (1950).

In view of the absence of fossils in the underlying beds, the thick fossiliferous Pound Sandstone, stratigraphically below the Archaeocyathinae marbles, has met with general acceptance in South Australia as the base of the local Cambrian sediments: below this the whole of the unfossiliferous (except for stromatoliths) succession is embraced by South Australian geologists under the title 'Adelaide System (Proterozoic)'.

In the succession outlined by David and Browne (1950), they divide the 'System' into an Upper and a Lower Series. Such subdivision is not in accord with the *Code*. Also the adoption of such terms would preclude the addition of any further series, should they ever be established in other areas. There are already grounds for anticipating such additions. The terms 'Torrensian', 'Sturtian', and 'Marinoan' respectively, are therefore proposed for three major series between the basal Aldgate Sandstone of the sequence in the type locality and the base of the fossiliferous Cambrian (the Pound Quartzite). The use of the series category is favoured in view of their probable intra-continental validity.

Browne's conception of 'Stage' subdivisions is obviously at variance with that defined in the new *Code*. The new definition of a Stage is that it is a major subdivision of a series, 'identified on the basis of its fossil content or of that of the overlying and underlying beds', and should be of world-wide applicability. It is therefore proposed that the Stage subdivision be dropped and that the Series be subdivided for the present only into Formations. This overcomes certain unrealities introduced, as in the case of the stage-separation of the uppermost laminated and banded siliceous limestones and slates from the remainder of the Tapley Hill laminated slates. Sedimentation is continuous throughout, and an arbitrary boundary can be drawn in the Adelaide area only with difficulty and in the Flinders Ranges possibly not at all. The Tapley Hill laminated slates and siliceous limestones constitute, therefore, a single Formation.

A revised subdivision of the succession as met with in the neighbourhood of Adelaide is detailed below; embodied therein are recent check measurements by one of us (Sprigg, 1942 and 1946).

The Adelaide System

As met with in the Adelaide Region—
the type area

	Thickness in feet
Marinoan Series: Thickness, about 5920 feet.	
Grey and flaggy quartzites with or without interbedded slates. This formation may correspond with the Pound Quartzite (Cambrian) of the Flinders Ranges and thus be above the Adelaide System. In the absence of fossils, however, its equivalence cannot be finally asserted	1150+
Chocolate quartzites and slates in part regularly alternating	2250
Massive grey quartzites with slate bands	300

Chocolate slates in part calcareous and dolomitic	140
Grey and purple quartzites, flaggy quartzites and slates	270
Chocolate and grey slates with a little calcareous arkose and thin bands of quartzite	300
Arkose, pebbly in part (Marino Arkose), and sandy limestone, and associated quartzite	180
Flaggy quartzites	200
Chocolate and grey flaggy quartzite and slate	500
Chocolate siliceous slates passing down into calcareous slates	630

Sturtian Series: Thickness, about 12,600 feet.

Brighton Limestone, in part oolitic blue below, buff coloured above	100
Tapley Hill laminated slates, becoming increasingly calcareous above	10,500
Sturt Tillite with interbedded glaciofluvial slates and quartzites	1000
Belair group, which includes the Mitcham quartzite (arkosic) (100 feet thick)	1000

Torrensian Series: Thickness 7450 to 9450 feet (range due to variable thickness of basal sandstone).

Glen Osmond slates with occasional thin dolomite bands	1540
Beaumont Dolomites and interbedded slates	450
Upper slates (and phyllitic phases) with minor quartzites and occasional thin dolomites	1000
Stonyfell (Mt. Lofty) Quartzite, in part arkosic and argillaceous	1000
Lower slates (and phyllites) with included minor quartzites	1100
Montacute Dolomite: blue and grey dolomites, limestones and sedimentary magnesites with chert bands and minor quartzites	430
Slates (and phyllites) with minor quartzites	680
Castambul Dolomite	150+
Slates (and phyllites)	100
Aldgate Sandstones, mainly argillaceous and in part ilmenitic; also with interbedded lenticular conglomerates and with recurrent argillaceous bands. This formation rests with violent unconformity on the underlying Barossian Complex.	1000-3000

Total thickness of the Adelaide System in the vicinity of Adelaide is 26,000 to 28,000 feet.

The Marinoan Series

This Series is characterized by red-bed conditions which followed the widespread Sturtian glaciation. In the Adelaide area the red-bed conditions commence almost exactly at the base of the series, although a purple limestone with intraformational brecciation, a few feet in thickness, occurs about 250 feet below its base. The series constitutes Howchin's transition or passage beds into overlying fossiliferous Cambrian strata. It includes a very mixed assortment of purple and chocolate slates and quartzites. Recent developments suggest that possibly the Marino Arkose and/or certain superimposed reddish beds are equivalents of the Elatina glacial horizon (Mawson, 1949).

The Sturtian Series

This group of beds is lithologically very dissimilar from either the preceding or following succession. It is essentially a glacial and glaciofluvial succession.

The Brighton Limestone at the top passes below through a succession of decreasingly calcareous, banded and laminated slates, the lower extensions of which are obviously glaciofluvial. In the Adelaide region the major tillite development overlies the Mitcham slate and quartzite group, which latter again reflects glacial conditions, expressed in arkoses and well-developed laminations, some of which have all the characters of true varves. Thus, this Mitcham Quartzite may be the equivalent of the Bibliando (lower) Glacigene Stage (Mawson, 1949) of the Flinders Ranges.

The Torrensian Series

This section is dominated by conditions favourable to the deposition of dolomite. The dolomites occur in a variety of forms, coloured white, grey or bluish black, and grade from dolomitic limestones to sedimentary magnesites, the latter often remarkable for their intraformational breccia structure.

The Torrensian Series consists essentially of a considerable thickness of slates and phyllites, including numerous dolomitic bands and thin quartzites. In the Adelaide region, the continuity of the section is complicated somewhat by the excessive development of the Stonyfell Quartzite (Howchin's 'Thick Quartzite'). In the Lobethal area this otherwise massive formation has been observed (Sprigg and Whittle) to grade into numerous thin sandstones with interbedded slates. Thus this development in the Stonyfell-Mt. Lofty area appears to be but a local thickening, for elsewhere to the north the normal succession is not interrupted by such a massive arenaceous interlude: there exists there a regular development of thin dolomites and slates, accompanied at intervals by relatively minor quartzites (Mawson, 1941B).

The name 'Beaumont Dolomites' is retained with formational significance and the 'Upper and Lower Torrens Limestones' are referred to

respectively as the Montacute and Castambul Dolomites.

The foregoing series of formations in the Adelaide area are underlain by argillaceous sandstones and sandy argillites with included ilmenitic sandstones and lenticular conglomerates. These form the Aldgate Sandstones. In the Flinders Ranges the dolomitic series is underlain by the massive Emeroo Quartzite, which, however, may not form the basal formation throughout the whole extent of the Flinders trough (Sprigg, 1949).

TYPE LOCALITIES

Brighton Limestone: Brighton Cement Quarries, Brighton.

Sturt Tillite: near Eden Station, south to Sturt Creek.

Mitcham Quartzite: Glen Osmond Quarry, one-third of one mile south of Glen Osmond tramway terminus.

Beaumont Dolomites: Beaumont Quarries, Beaumont.

Stonyfell Quartzite: north-south section immediately east of Stonyfell quarries.

Montacute Dolomite: east side of Pinkerton Gully, two-thirds of one mile west of Castambul.

Castambul Dolomite: Torrens Gorge, one half-mile W-N-W of Castambul.

Aldgate Sandstone: section along road, two to three miles E-S-E of Mt. Carey.

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Commonwealth Universities Conference*

THE Executive Council of the Association of Universities of the British Commonwealth met in August at Wairakei, New Zealand. Representatives were present from the United Kingdom, Canada, India, Pakistan, South Africa, Australia, the universities and university colleges of the Colonies, and New Zealand. The first overseas meeting was held in Canada at Halifax in 1949. The next meeting of the Executive Council is to be held in India in January 1952 at the invitation of the Inter-University Board of India. This will be the third meeting of the Council in a country outside the United Kingdom since the Congress of the Universities of the Commonwealth at Oxford in 1948.

The discussions covered a wide variety of matters, including the development of closer academic contact among members of the Commonwealth; the provision of adequate financial support to universities from central and local governments; the relation of the university to the government; and the provision of adequate superannuation with a high degree of interchangeability between countries as well as among government, scientific and research institutions within each country. Additional problems considered were the growing importance of technological training and its place in the universities, the greater emphasis being placed upon graduate studies, standards of admission to the universities and the recognition of courses and degrees among the universities of the Commonwealth. As regards academic contacts it was emphasized that closer contact among all member countries should be fostered as well as contact between the United Kingdom and the other members of the Commonwealth. It was the desire of the Association to interchange academic personnel among all members. There are, fortunately, increasing opportunities for members of university staffs to visit universities in other countries, sometimes through special arrange-

* From information and comment supplied by the Vice-Chancellor of the Australian National University, Sir Douglas Copland.

ments by the governments of individual countries, sometimes through assistance given for this purpose by American and British foundations. As the financial conditions of the universities improve it should be possible to extend these facilities. Further developments on the same lines might come from the adoption of the practice of seconding professors or lecturers for a short period to universities in other countries where they would widen their experience and at the same time contribute to the academic development of the countries to which they were temporarily attached. It was also emphasized that in making permanent appointments the widest area should be drawn upon, and this would be facilitated if superannuation rights were interchangeable among the universities of the Commonwealth. Not less important was the development within each country of mobility for university men and scientific workers. No university in the modern world can work in isolation, and no modern community can afford to treat its own academic structure as a thing apart from the main stream of political and economic development.

On the increased importance of technology in the modern industrial community, the conference drew attention to the great expansion of university studies in this field over recent years. Apart from the traditional disciplines of medicine, engineering and science, both teaching and research had been developed in agriculture, veterinary science, architecture, dentistry, chemical engineering, metallurgy, various industrial processes, and home science. Further progress is being made in association with advanced technical colleges, and the universities are making available an increasing number of graduates with technical proficiency in a wide field of modern industry and agriculture. No university can train a man for immediate responsibility in a technical position in modern industry, but all universities are training men who will be qualified to hold such posts after they have acquired the necessary experience. It is wrong to suppose that there is any conflict between the university's concept of scientific training and the technological training required in modern industrial practice. The proper place for higher training is the universities, which are fully alive to the needs of modern industry. They must not, however, be diverted from their main task by attempting to supply modern industry with craftsmen or technicians. The training of these is already carried on by secondary schools and technical colleges of a specialized type.

The most important problem now facing universities is perhaps the functional relationship between the universities and the government. Much heavier claims are now made on the universities, both for undergraduate teaching in a wider range of subjects and also for the training of graduate scholars as well as for the pursuit of fundamental research. Research has always been recognized as a special responsibility of universities and it is of even greater importance now that so much development in both government and private enterprise depends upon the advancement of knowledge. If the Commonwealth countries are to keep abreast of technical advances and the complex administration of the modern world, the universities must play an increasingly important part.

In discussions on this important phase of the conference business, representatives of most countries reported considerable advances over pre-war conditions. Governments are giving more and more financial assistance and the universities have worked out or are now working out special arrangements with the governments whereby their needs can be met without interference with their academic independence. But the picture is by no means uniform. Great advances have been made in some countries and limited progress in others. In the United Kingdom, for example, the Treasury grants to the universities for current expenditure have risen from about m£2½ in 1939 to m£13 in 1950-1951, the grants having been fixed in advance at an increasing rate for a period of five years. The United Kingdom position is distinguished by the initiation after the first world war of the practice of fixing grants for a five-year period and by the existence of a University Grants Committee which stands between the Treasury and the universities as an agency for considering and reporting upon the needs of the universities and for the allocation to universities of the money voted by Parliament for the purpose. Important progress has been made in all the colonies where new universities have been established since the war. In Australia special machinery is being devised for financial contributions by the central government to the universities on terms that will be acceptable to the States and to the universities, and in Canada discussions towards a similar goal are taking place. In South Africa somewhat more than half of the university income is provided by the Union Government. None is contributed by the Provincial Governments, while municipalities give small amounts. Negotiations are in hand to adjust the Union contribution on a more equitable basis. In the new Commonwealth countries, India and Pakistan, financial assistance is given mainly by the States and in special circumstances by the central government; while in New Zealand the responsibility for developing the university colleges is increasingly a matter for the government. In the colonies, higher educational institutions are financed almost entirely by governments.

Certain general principles emerged from the discussion on this problem. In the first place, the scale of governmental assistance should be adjusted to the wider responsibilities which the universities are required to assume and to the increasing cost of university education, both undergraduate and graduate. In all countries

larger grants were essential if the universities were to play their part in national development, in the advancement of learning and in the maintenance and promotion of cultural standards. Secondly, machinery was required under which it would be possible for the governments and the universities to be in constant consultation on problems of university development. The pattern would differ, but in all countries national bodies representative of the universities should exist and remain in close contact with the government on university needs. It was only in this way that a balanced development of universities would be ensured. Thirdly, it was of vital importance that the principle of academic independence should be preserved. This was one of the basic conditions of freedom in a modern community, and fortunately it was not in peril in any of the Commonwealth countries. At the same time it had to be recognized that governments would need to be fully informed by the universities of their needs and would have to provide money on an increasing scale to enable the plans of the universities to be realized and standards of work and emoluments maintained. Consultation on these and other problems did not interfere with the preservation of the universities as corporate bodies of scholars with independence in their teaching and research and autonomy in the conduct of their internal affairs.

The International Joint Commission on Oceanography*

THE *International Joint Commission on Oceanography* was set up in 1947 under the International Council of Scientific Unions, by joint action of the International Union of Geodesy and Geophysics and the International Union of Biological Sciences. The following members were appointed by the International Union of Geodesy and Geophysics: Professor B. Helland Hansen (Norway), Dr. Harald Sverdrup (Norway), Professor Hans Pettersson (Sweden), Professor J. Proudman (Great Britain). By the International Union of Biological Sciences: Professor H. Boschma (Convener and Chairman), Dr. C. von Bonde (South Africa), Professor Louis Fage (France), Dr. Charles Fish (U.S.A.). The following additional members have since been co-opted: Lt.-Col. R. B. Seymour Sewell (Secretary), Dr. E. C. Bullard (Director, National Physical Laboratory, Teddington), Professor Dr. Ph. H. Kuenen (Holland), Professor R. Sparck (Denmark), Dr. J. D. H. Wiseman (England), and (in response to an invitation to the International Council for the Exploration of the Sea) J. R. Lumby (England).

No specific instructions were given to the Commission, which was asked to enquire what could be done for furthering the study of oceanography. It was decided to appoint a liaison officer for each country that should be interested in the study of oceanography, and the following have been appointed: Argentina, A. E. Rigi; Austria, A. Defant; Chile, F. Riveros-Zuniga; China, Ling Shao-wen; Cuba, L. H. Rivero; Brazil, W. Besnard; Egypt, Professor Faouzi; Guatemala, R. de Buen; Hong Kong, Dr. Herklots; India, S. L. Hora; Italy, Professor F. Vercelli; Mexico, R. Nunez; Norway, Professor Ruud; Peru, E. Schweiger; Portugal, Dr. Ramalho; Sweden, Professor V. W. Ekman; Spain, F. P. Navarro; Uruguay, Professor F. de Buen.

Three meetings of the International Joint Commission have been held, namely: London, 1947; Oslo, 1948; Newcastle, 1949. It is hoped that the next session will be held in Brussels in 1951, simultaneously with the meeting of the International Union of Geodesy and Geophysics.

Proposals for action put forward by the International Joint Commission include:

1. To establish liaison between workers in the field of deep-sea research and more especially work on the deep ocean floor, its morphology, stratigraphy and other properties of its sediment carpet and its substratum, as well as the water layers next to the bottom and the abyssal fauna inhabiting it. Suggestions for a programme of deep-sea biological research include: *a*. Design of experimental apparatus for the investigation of the bottom fauna; *b*. Study of the invertebrate fauna in great depths; *c*. Micro-fauna of the detritus layer; *d*. Metabolism in animals living at temperatures below zero; *e*. Quantitative study of animal associations on the oceanic slopes; *f*. The fauna of the abyssal plains and deeps; *g*. Pelagic micro-organisms; *h*. Ecology of the Foraminifera; *i*. Nutrition of deep-sea organisms.

2. The standardization of oceanographic practice at sea and of the methods of chemical analysis of sea-water.

To encourage co-operative work between different marine laboratories as a means of collecting simultaneous observations at sea on specific problems throughout the oceans of the world with particular emphasis on problems affecting fisheries.

3. To try to promote the establishment in each of the different oceanic areas (especially in those areas in which F.A.O. is trying to set up International Councils for the exploration of the sea and for the promotion of fisheries) of oceanographic laboratories to study the con-

* Information supplied by the Secretary, Dr. R. B. Seymour Sewell, The Zoological Laboratory, Cambridge, England, through the Secretariat of the Pacific Science Council (Bishop Museum, Honolulu 17, Hawaii).

ditions in the sea in connexion with, but beyond, the regions in which fishery research vessels will be carrying out their investigations.

4. To establish a Secretariat or Bureau, with a head office, to act as a centre for receiving and passing on to interested parties in different countries information about work in deep-sea research, both such as is actually proceeding and such as is being planned.

The Sydney Scientific Film Society

THE greatly increased use of cinematography for research and for teaching technical subjects to civilians and service personnel that occurred during the recent war brought film makers and scientists into close contact. One of the results of these new contacts was the establishment in England, in 1943, of the Scientific Film Association, whose main object was to further the use of scientific films. Within the Association a number of experts' committees were formed, charged with appraisal of films, the compilation and publication of catalogues, and the development of the educational use of films at all levels. The work of the Scientific Film Association received official recognition in 1949, when it was allotted a monetary grant from the Government of the United Kingdom.

In Sydney, during June of the present year, a number of scientists and film makers met and decided that the time was opportune to start a similar movement in Australia. On 15 September, at a meeting held in the Wallace Theatre, University of Sydney, under the chairmanship of Professor P. D. F. Murray, it was resolved to form the Sydney Scientific Film Society. The meeting, numbering about three hundred, gave general approval to the aims as drafted by the convening committee, namely:

1. To screen regularly a selection of scientific films.
2. To provide a central repository of data concerning all types of scientific films.

Following the meeting, a number of films were shown, including *Le Cinéma au service de la Science*, *Atomization*, and *Arnhem Land*.

At a second meeting, held on 23 October, a constitution was adopted and officers and members of council were elected. Professor P. D. F. Murray became the Society's first President. At the conclusion of the formal business several films were shown, including *The Phase Contrast Microscope*, *Life with Baby* (a review of some psychological research at Yale University), and a film dealing with photoelasticity made in the Faculty of Engineering of the University of Sydney. It is planned to hold regular meetings, in the Wallace Theatre, for the showing of films on a wide variety of scientific subjects.

Active steps are also being taken to fulfil the second of the Society's objectives. A card index of over a thousand scientific films available in Sydney has been collected, and it is hoped shortly to publish this list in catalogue form. An appraisal committee has been set up and the first appraisal screenings will soon be held. The Society is anxious to compile a register of research films taken by scientists in the course of their work, in any part of Australia, and in any branch of science.

The *Comité permanent du Film de Recherche*, a sub-committee of the International Scientific Film Association, has recently set up an International Reference Library in Europe, and is anxious to receive reprints of scientific papers in which the use of cinematography for research purposes is described. It is the intention of the Sydney Scientific Film Society to co-operate in this international work.

All enquiries should be sent to the Secretary of the Society: Dr. A. R. Michaelis, Department of Aeronautical Engineering, University of Sydney.

Obituary

Gustavus Athol Waterhouse

IN the death of Gustavus Athol Waterhouse on 29 July 1950, science in Australia has lost a devoted student who for the past forty years had worked unceasingly in its behalf. Not only was he an active worker in the field of entomological research, but throughout his life he took a keen interest in the management of many scientific societies. In the scientific journals of these various societies, whose financial and other interests he fostered, he had contributed many papers on Australian butterflies, in which he dealt with their taxonomy, life-histories, and the results of breeding experiments.

The magnificent collection of Australian and Indo-Pacific Rhopalocera, which he had first commenced in 1893, was formally presented to the Australian Museum some twenty years ago. Of this collection it is interesting to read the tribute paid to it by Brigadier W. H. Evans in his recent work, *A Catalogue of the Hesperiidae from Europe, Asia and Australia in the British Museum (Natural History)*, where in the Introduction he writes:

> It can be stated with confidence that the collection of Hesperiidae in the British Museum (Natural History) is the most complete in existence in respect of Europe and Asia, while for Australia it is only surpassed by the great collection assembled by Dr. G. A. Waterhouse in the Australian Museum at Sydney.

Brigadier Evans was familiar with this collection, having worked at it during his stay in

Sydney in March-May 1932. Dr. Waterhouse had served the Australian Museum in the capacities of Hon. Entomologist (1919-1950); Elective Trustee (1929-1947); President of the Board of Trustees (1930).

He was born on 21 May 1877, at Waverley near Sydney, and was educated at the Sydney Grammar School and the University of Sydney, where he graduated B.Sc. (1899) and B.E. (1900). In 1924 he was awarded the D.Sc. by his university for his researches on the hybridization of certain butterflies of the genus *Tisiphone*.

Upon leaving the University in 1900, he entered the Royal Mint, Sydney, and was Assistant Assayer from 1 April 1900 to 31 December 1926. When the Mint was closed he retired, but spent much time in assisting on the councils of such bodies as the Australian National Research Council, the Australian and New Zealand Association for the Advancement of Science, the Royal Society of New South Wales, the Linnean Society of New South Wales, the Royal Zoological Society of New South Wales, the New South Wales Naturalists' Club, and the Naturalists' Society of New South Wales. He had occupied the presidential chair for most of the societies above-mentioned, or had acted as secretary or treasurer on other occasions.

It was while President of the Zoology Section of A.N.Z.A.A.S. at Auckland in January 1937 that he embodied the results of his entomological researches made in England in 1936, in his Presidential Address: *The Biology and Taxonomy of the Australasian Butterflies*. Apart from his many contributions to scientific journals, he will be remembered by entomologists for his two fine works, *The Butterflies of Australia* (written in collaboration with G. Lyell, 1914), and *What Butterfly is That?* (1932), illustrated in colour by the late Neville Cayley.

The later years of his life were claimed by ill-health, but he retained an interest in entomology up to the last. A widow, two sons and two daughters survive him; another son was killed in New Guinea during the last world war. From this brief review of his varied activities it will be seen that the position which he formerly occupied among his scientific colleagues will be extremely difficult to fill.

A. Musgrave.

News

Rutherford Memorial Fund

The Council of the Royal Society appeals for financial support for the creation of a suitable memorial to that great figure in twentieth-century science, the late Lord Rutherford of Nelson.

A Rutherford Memorial Committee has been set up, comprising Sir Henry Tizard (Chairman), Professor E. N. da C. Andrade, Sir James Chadwick, Sir Charles Darwin, Professor A. V. Hill and Professor M. L. E. Oliphant. After consideration the Committee has proposed that the memorial shall take two forms:

(1) Rutherford Scholarships tenable for three years, to be awarded to post-graduate students within the British Commonwealth, for research in the natural sciences with a preference for experimental physics. A scholar will normally be required to carry out his research in an institution in some part of the British Commonwealth other than that in which he graduated.

(2) A Rutherford Memorial Lecture to be delivered at intervals at selected university centres in the British Commonwealth overseas, at least one in three to be given in New Zealand.

It is proposed also to arrange for the collection, arrangement and binding of copies of Rutherford's correspondence, and its preservation in safe custody for future reference.

For these purposes a substantial endowment fund will be needed, and it is hoped that this appeal will meet with a generous response. Contributions may be sent to the Rutherford Memorial Committee, The Royal Society, Burlington House, London, W.1.

Pacific Science Congress

The organization of the Eighth Pacific Science Congress is to be undertaken by the National Research Council of the Philippines. The following have been named as the organizing committee.

President: B. M. Gonzales, Professor of Animal Husbandry and President of the University of the Philippines, Quezon City.

Secretary-General: Patrocinio Valenzuela, Professor of Pharmaceutical Chemistry, University of the Philippines.

Assistant Secretary-General: Alfredo C. Santos, Professor of Pharmaceutical Chemistry, University of the Philippines.

Secretaries: Oceanography—D. V. Villadolid, Bureau of Fisheries, Manila; Anthropology—Professor H. O. Beyer, University of the Philippines; Nutrition—J. Salcedo, Jnr., University of the Philippines; Meteorology — C. del Rosario, University of the Philippines; Geology—J. M. Feliciano, University of the Philippines; Public Health—H. Lara, University of the Philippines.

Sarawak Museum

The Sarawak Museum, Kuching (Curator: T. Harrisson) is anxious to arrange exchange of publications and specimens. It has extensive ethnographical and archaeological collections;

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,
December, 1950
EDITOR: STEPHEN J. COPLAND, c.o. Linnean Society of N.S.W.,
Science House, Gloucester Street, Sydney.

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ENTOMOLOGY.

Hon. Abstracter: A. Musgrave

(Continued.)

15487. **China, W. E., and Usinger, R. L.** Classification of the Veliidæ (Hemiptera) with a New Genus from South Africa. *Ann. Mag. Nat. Hist.*, (12) ii (17), May, 1940 (=19 Aug., 1949), 343–354, tfs. 1–2.

15488. **Clark, L. R.** Observations on the Plant Communities at "Bundemar," Trangie District, New South Wales, in relation to *Chortoicetes terminifera* (Walk.) and *Austroicetes cruciata* (Sauss.). *Bull. C.S.I.R.*, Melbourne, No. 236, 1948, 1–63, pls. 1–5.

15489. **Clark, L. R.** Behaviour of Swarm Hoppers of the Australian Plague Locust, *Chortoicetes terminifera* (Walker). *Bull. C.S.I.R.O.*, Melbourne, No. 245, 1949, 1–27, tf. 1.

15490. **Clark, L. R.** On the Abundance of the Australian Plague Locust, *Chortoicetes terminifera* (Walker) in Relation to the Presence of Trees. *Aust. J. Agric. Res.*, i (1), Jan, 1950, 64–75.

15491. **Clay, Theresa.** Systematic Notes on the Piaget Collection of Mallophaga. Part I. *Ann. Mag. Nat. Hist.*, (12) ii (23), Nov. 11, 1949, 811–838.

15492. **Clay, Theresa.** Systematic Notes on the Piaget Collections of Mallophaga. Part II. *Ann. Mag. Nat. Hist.*, (12) ii (24), Dec. 14, 1949, 895–921, tfs. 1–6.

15493. **Common, I. F. B.** The Yellow-winged Locust, *Gastrimargus musicus* Fabr., in Central Queensland. *Q'land J. Agric. Sci.*, Brisbane, v (iv), Dec., 1948, 153–219, pls. 1–15.

15494. **Coombe, B. G.** Insect Pests and Diseases of Grape Vines in South Australia. *J. Dept. Agric. S. Aust.*, liii (7), Feb., 1950, 279–293, illustr.—Erinose mite or vine leaf blister mite, *Eriophyes vitis.* Vine Mite, *Tenuipalpus californicus.* Light Brown Apple Moth, *Tortrix postvittana.* Cutworms. Vine Moth, *Phalænoides glycine* Lew. Curculio Beetle, *Otiorrhynchus cribricollis* Gyll. Vine Hawk Moth, *Hippotion celerio.* Vine Scale, *Lecanium berberidis.*

15495. **Corbet, A. S. (the late).** The Linnean Names of Indo-Australian Rhopalocera. Part VI. The Case of *Papilio plexippus* Linnæus, 1758. *Proc. R. Ent. Soc. Lond.*, (B) xviii (9–10), 17 Oct., 1949, 184–190.

15496. **Corbet, A. S. (the late).** The Linnean Names of Indo-Australian Rhopalocera. Part VII. Summary of Determinations. *Proc. R. Ent. Soc. Lond.*, (B) xviii (9–10), 17 Oct., 1949, 191–199.

15497. **Corporaal, J. B.** Sixth Series of Notes on Systematics and Synonymy. (33rd Communication on Cleridæ.) *Entom. Ber.*, xii (291), 1 July, 1949, 398–399.—Under *Teneropsis* Chapin, 1924, lists all Indo-Australian "Pelonii", including *australicus* Lea, 1906, Sydney; *jocosus* Schklg., 1908, N.E. Australia.

15498. **Corporaal, J. B.** The Variability of *Paratillus carus* Newm. (Col., Cleridæ). (34th Communication on Cleridæ.) *Ent. Mo. Mag.*, lxxxv (1021), June, 1949, 156. The species is widely spread in the Australian region, including Tasmania and New Caledonia. The colour aberrations apparently occur everywhere with the typical form, with the exception perhaps of ab. *sumatranus* Kr., which was described after a single specimen from south-west Sumatra (where so far as the author knows it has never been found again), but which also occurs in N.S.Wales and Tasmania.

15499. **Corporaal, J. B.** Tenth Series of Notes on Systematics and Synonymy. *Entom. Ber.*, xiii (298), 1 April, 1950, 59–61.—Places *Lebasiella duboulayi* Pic (L'Echange, lxvi—519, 1950, p. 2) from Swan River in the genus *Korynetes* Herbst.

15500. **Couchman, L. E.** Notes on Geographical Races of *H. chrysotricha*. *Pap. Proc. R. Soc. Tasm.*, 1948 (1949), 65–73, pl. i. Issued separately 15 Sept., 1949. Describes and figures *Hesperilla chrysotricha plebeia* Waterhouse, 1927, Tasmania. *H. chrysotricha* subsp. *lunawanna* n. subsp. South Bruny Is., Tas. *H. chrysotricha* subsp. *naua* n. subsp. Pt. Lincoln distr., S. Aust. Gives affinities with mainland subspp.

15501. **Day, M. F.** The Occurrence of Mucoid Substances in Insects. *Aust. J. Sci, Res.*, ii (iv), Nov., 1949, 421–427.

15502. **Drake, C. J.** Australian Tingidæ. *Bull. S. Calif. Acad. Sci.*, xlvi (3), Sept.-Dec., 1947 (Issued April 20, 1948), 111–121, 3 pls.—*Nethersia maculosa* Horvath, 1925. Type female, Broome, in Stockholm Mus. descr. ♀ and ♂. *Paracopium*

summervillei (Hacker), 1927. Described from Palm Is., N.Q. Two paratypes studied. Breeds on *Scævola koenigii* Vahl. Other spms. examined: 4, Dunk Isl., Aug. 27, 1927; 3, Bowen, Q., June 21, 1930; 2, Prince of Wales Is., Torres Strait; 1, New Hebrides, March 15, 1943. *Leptophya anceps* (Horvath), 1925. The type (male), Yarrabah, and 2 males, Dunk Is., have been examined. *Tingis impensa* n.sp. Tasmania, type, female. *T. hurdæ* n.sp. Q'land, type male. *T. æmula* n.sp. S.A.: Ooldea, type female. *T. muiri* n.sp. Q.: Coolangatta, type (male), allotype (female) and 3 paratypes, coll. Muir. *T. acris* n.sp. Q.: Benakin, type (male), allotype and 2 paratypes. *T. perkinsi* n.sp. Q.: National Park, type ♂, allotype ♀, paratypes. Many specimens taken with type and from Mt. Glorious. *T. hackeri* n.sp. Q.: National Park, type ♂, allotype ♀. *T. teretis* n.sp. S.A.: Ooldea, type ♂. *Froggattia disticha* n.sp. Q.: Cedar Ck., holotype ♀. *Teratocheila accedentis* n.sp. Aldgate, type ♀, paratype. *Physatocheila suttoni* n.n. for *P. irregularis* Hacker, 1929, preoccupied by that of Mont. and Sign., 1861, Q'land (E. Sutton).

15503. **Dunn, R. A.** New Pedipalpi from Australia and the Solomon Islands. *Mem. Nat. Mus.*, Melbourne, No. 16, Dec., 1949, 7–15, tfs. 1–6.—Family Tarantulidæ: *Charinus* Simon, 1892, gives synopsis of species and describes as new *C. pescotti* from Q.: Barron Falls and Solomon Group: Savo Is.; also *Stygophrynus* subg. *Neocharon* nov. *S.* (*N.*) *forsteri* sp.n. Solomon Group: Savo Is.

15504. **Edwards, G. R.** Insect Pests of Vegetable Crops. *J. Dept. Agric. S.A.*, liii (12), July, 1950, 544–554, illustr.—Insect pests of cabbages, etc.: Cabbage White Butterfly, *Pieris rapæ* L. Cabbage Looper, *Plusia* sp. Cabbage Moth or Riddler, *Plutella maculipennis* Curt. Slatey Grey Cabbage Aphid, *Brevicoryne brassicæ* L. Cutworms (Noctuidæ). Black Beetle, *Heteronychus sanctæ-helenæ* Blanch. Brown Vegetable Weevil, *Listroderes costirostris* Schh. Snails and slugs.

15505. **English, Kathleen M. I.** Notes on the Morphology and Biology of a New Species of Tabanus (Diptera Tabanidæ). *Proc. Linn. Soc. N.S.W.*, 1949, lxxiv (3–4), 21 Oct., 1949, 153–160, 15 tfs.—*Tavanus orarius* n.sp. N.S.W.: Narooma, Sydney, and Rockhampton (Macleay Mus.). Types in Macleay Mus.

15506. **Entomological Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lx (10), Oct., 1949, 539–542, illustr.—Snails and Slugs (*Helix aspersa* and *Limax* sp. control. Recent floodings and possible cutworm plagues. Control.

15507. **Entomological Branch.** Insect Pests. Carpet Beetles and Clothes Moths. *Agric. Gaz. N.S.W.*, lx (11), Nov., 1949, 591–594, illustr.—Carpet Beetles, *Anthrenus verbasci* and *Attagenus* sp. Case-making Clothes Moth, *Tinea pellionella*, Webbing Clothes Moth, *Tineola bisselliella*, Tapestry Moth, *Trichophaga tapetzella*. Control.

15508. **Entomological Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lx (12), Dec., 1949, 651–654, illustr.—The House Fly, *Musca domestica*. The Leaf-eating Ladybird, *Epilachna 28-punctata*. Control.

15509. **Entomological Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lxi (1), Jan., 1950, 37–40, illustr.—Grass Itch Mites, *Acomatacarus australiensis*. Fleas (Pulicidæ). Control.

15510. **Entomological Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lxi (2), Feb., 1950, 87–90, 92, illustr.—Large Citrus Butterfly, *Papilio ægeus*. The Small Citrus Butterfly, *P. anactus*. The Orange-barred Grass Moth, *Eutane terminalis*. The Bed or House Bug, *Cimex lectularius*. Control.

15511. **Entomological Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lxi (3), March, 1950, 143–146, illustr.—Mosquitoes (Culicidæ). *Culex fatigans*, *Ædes ægypti*, Anophelini. Leaf-eating Ladybird, *Epilachna 28-punctata*. Control.

15512. **Entomological Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lxi (4), April, 1950, 199–202, illustr.—Mole Crickets, *Gryllotalpa* sp. Cockroaches (Blattidæ). Control.

15513. **Entomological Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lxi (5), May, 1950, 253–256, illustr.—White Louse Scale, *Unaspis citri*. Psocids or Book-lice (Psocoptera). The Beet Web-worm, *Hymenia recurvalis*. Control.

15514. **Entomological Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lxi (6), June, 1950, 303–306, illustr.—The Bronze Orange Bug, *Rhoecocoris sulciventris*. The Harlequin Bug, *Dindymus versicolor*. A Native Plant Bug, *Leptocoris lurida*. Control.

15515. **Entomological Branch.** Insect Pests. *Agric. Gaz. N.S.W.*, lxi (7), July, 1950, 369–372, illustr.—Grape Vine Mites: The Vine-leaf Blister Mite, *Eriophyes vitis*. The Vine-Berry or Bunch Mite, *Tenuipalpus californicus*. The Grape Rust Mite, *Colepitrimerus vitis*. The Vegetable Weevil, *Listroderes obliquus*. Control.

15516. **Fennah, R. G.** New Exotic Fulgoroidea. *Ann. Mag. Nat. Hist.*, (12) ii (20), Aug., 1949 (=7 Oct., 1949), 585–606, tfs. 1–14.—Family Cixiidæ: *Dysoliarus* g.n. Orthotype, *D. unicornis* sp.n. Dedari, 40 miles west of Coolgardie, W.A. Family Issidæ: *Alleloplasis* Waterhouse, 1837, Haplotype, *A. darwini* Waterh. *A. vespula* sp.n. W.A.: Perth, compared with *A. darwini* Waterh. type loc. King George's Sound. Family Achilidæ: *Aneipo* Kirk. Haplotype, *A. diva* Kirk. *A. ceres* sp.n. Q.: Mt. Tambourine compared with *A. diva* Kirk. *A. diana* sp.n. Q.: Kuranda.

15517. **Forster, R. R.** Australian Opiliones. *Mem. Nat. Mus. Vict.*, xvi (Dec., 1949), 59–89, tfs. 1–44.—Suborder Palpatores. Family Phalangiidæ. Subfamily Megalopsalinæ nov. subfam. *Megalopsalis* Roewer, 1923. *M. hoggi* (Pocock, 1902), V.: Macedon (type ♂); Golden Square (south of Bendigo); S.A.: Ashbourne, Myponga, Sandy Creek. *Spinicrus* n.g. Genotype, *Pantopsalis tasmanica* Hogg, 1910; *S. camelus* n.sp. N.S.W.: Tubrabucca. *S. stewarti* n.sp. V.: Mt. Buffalo, from Snow Gum, *Eucalyupts pauciflora*. Nodala n.g. Genotype, *Nelima dunni* Forster, 1948. Suborder Laniatores. Family Triænonychidæ. Subfam. Triænonychinæ. Key to Australian genera. *Nunciella* Roewer, 1928; *N. tuberculata* n.sp. V.: Diamond Creek (type loc.), Warburton, Kallista, under logs. *Paranuncia* Roewer, 1914.

Genotype, *P. gigantea* Roewer, 1914. Tasmania. *P. ingens* Roewer, 1931, V.: Cockatoo (type loc.), Dandenong Ranges, Warburton, Gippsland, Diamond Ck., Ferntree Gully, Kallista. *Lomanella* Pocock, 1903; *L. kallista* n.sp. V.: Kallista. *Conoculus* n.g. Genotype, *C. asperus* n.sp. S.A.: Glen Osmond. Family Assamiidæ. Subfam. Dampetrinæ. *Dampetrus* Karsch, 1880. *D. gracilis* n.sp. V.: Redcliffs. *Euwintonius* Roewer, 1923; *E. continentalis* Roewer, 1923, N.T.: King Is., redescribed.

15518. **Fullaway, D. T.** Notes on Parasites of Tephritid Flies. *Proc. Haw. Ent. Soc.*, xiv (1), March, 1950, 27–28.—Mr. Krauss' shipments of fruit fly parasites from Australia reveal five species: 3 new described, *op. cit.*, pp. 65–67, and *Opius longicaudatus* (Ashmead) and *O. fletcheri* Silv. Gives notes on these and *O. persulcatus* (Silv.), and discusses synonymy.

15519. **Fullaway, D. T.** Fruit Fly Parasites Collected in Queensland by N. L. H. Krauss in 1949 (Hymenoptera: Braconidæ). *Proc. Haw. Ent. Soc.*, xiv (1), March, 1950, 65–67.—*Opius deeralensis* n.sp. Reared from *Dacus* (*Strumeta*) *laticaudus* Hardy, pupæ ex *Planchonella*, Deeral, Australia. *O. perkinsi* n.sp., described from 3 ♂, 2 ♀ specimens, reared from *Dacus laticaudus* Hardy, pupæ ex *Planchonella* collected at Deeral, Australia, 1949. Types in Hawaii. Ent. Soc. coll. *Opius froggatti* n.sp., reared from *Dacus laticaudus* Hardy, pupæ ex *Planchonella*, collected at Deeral, Australia, 1949. Types in Hawaii. Ent. Soc. coll. ? *Opius longicaudatus* (Ashm.), from ex *Planchonella*-infesting *Dacus* at Deeral, and from *Solanum*-infesting pupæ on the Atherton tableland. ? *O. fijiensis* Full., ex pupæ of *Planchonella*- and *Acmena*-infesting fruit flies collected at Deeral. ? *O. persulcatus* (Silv.), from pupæ obtained from *Solanum auriculatum* on the Atherton tableland, Aug., 1949.

15520. **Gellatley, J. G.** Use of D.D.T. and H.E.T.P. Sprays Against the Green Vegetable Bug. *Agric. Gaz. N.S.W.*, lx (8), Aug., 1949, 458.

15521. **Ghesquière, J.** Contribution à l'étude du genre *Aneristus* Howard (Hym. Chalcidoidea Aphelinidæ). *Bull. Ann. Soc. Entom. Belg.*, lxxxv (5–6), 10 July, 1949, 156–167, tfs. 1–4.—In catalogue and key to spp. the author refers to forms recorded from Australia.

15522. **Glauert, L.** Some Western Australian Mallophaga. *Emu*, xlix (2), Oct., 1949, 129–131.—Lists species of Mallophaga from Western Australian birds and mammals which have been identified by Miss Theresa Clay (British Museum) and gives notes thereon.

15523. **Gross, G. F.** The Stilt-bugs (Heteroptera-Neididæ) of the Australian and New Zealand Regions. *Rec. S. Aust. Mus.*, ix (3), June 30, 1950 (reprint received Aus. Mus. 26 June, 1950), 313–326, tfs. 1–4.—Key to genera. *Neides* Latreille, 1802. Key to spp. *N. tasmaniensis* sp.n. T.: Hobart, Launceston, N.S.Wales. *N. wakefieldi* Buch.-White, 1878. N.Z.: Wellington, Wanganui, Canterbury, rare in the North Islands, taken in December and April. *N. maiponga* sp.n. S.A.: Myponga, from small swamp; Adelaide: Cape Jervis area, from Acacia in creek; T.: New Norfolk, in tussock. *Capyella* Breddin, 1907; *C. lobulata* Bergroth, 1909, syn. *Metatropis tipularius* Distant, 1911, Northern Territory. *Metacanthus* Costa, 1838, key to Australian spp. *M. pertenerus vittatus* subsp. nov. N.T.: Roper River. *M. pluto* sp.n. Q.: Bunya Mts., Magnetic Is.; N.S.W.: Upper Williams River. *Gampsocoris* Fuss., 1852; *G. pulchellus* (Dallas), 1852, India, Java, New Guinea (Misima Is.), Australia (Darwin). *Protacanthus* Uhler, 1893; *P. halei* sp.n. S.A.: Moolooloo, 2000 ft., Flinders Ranges.

15524. **Gross, G. F.** On a New Species of Cryptostemmatidæ (Hemiptera-Heteroptera) from Australia. *Rec. S. Aust. Mus.*, ix (3), June 30 (reprint received Aust. Mus. 26 June, 1950), 327–329, tf. 1.—*Ceratocombus* (*Xylonannus*) *australiensis* sp.n. S.A.: Tapanappa, near Cape Jervis; holotype and allotype. Paratypes: Mt. Lofty, Gawler and Melrose, S.A.; Waratah and Strahan, T.; Upper Williams River, N.S.W.; Mt. Tambourine and Cairns district; Q.: Lord Howe Island.

15525. **Hadlington, P.** Forest Insects and Wood-destroying Insects of N.S.W. Part I. A. Insects Attacking the Living Tree. *Technical Notes* (*Div. Wood Tech., Forest Comm. N.S.W.*), Sydney, iv (7–9), 1950, 3–5, illustr.—Leaf-eating insects: *Roeselia lugens*, larva "Gum Itch Grub"; *Anaphæis java teutonia*; *Charaxes pyrrhus sempronius*, on *Acacia*; *Chelepteryx collesi*, on *Eucalyptus hæmastoma*; *Doratifera vulnerans*, defoliating *Tristania* and *Eucalyptus* spp.; *Panacela lewinæ*, constructs bag shelters in a number of Eucalypts, occurring mostly on the northern tablelands; *Ochrogaster contraria*, bag shelters in Boree, *Acacia pendula*, widely distributed; *Thyridopteryx hubneri*, pest of *Pinus radiata*, coastal; *T. herrichii*, attacks *Eucalyptus cladocalyx*, etc., wide range in N.S.W.; *Sylepta clytalis*, attacks Kurrajongs, makes bag shelters, coastal. Sawfly (Hymenoptera) Leaf-eaters: *Perga dorsalis*, attacks several spp. of eucalypts; *Pterygophorus analis*, attacks ironbarks, causing severe defoliation; *Zenarge turneri*, defoliates Cypress Pine, coastal and inland. Beetle (Coleoptera) Leaf Eaters: *Liparetrus phœnicopterus*, causes severe defoliation or death of shade trees. Western districts of N.S.W. and slopes; *Chrysophtharta varicollis* and *C. cloelia*, attacks Flooded Gum plantations. North Coast, N.S.W. Leaf Miners: *Acrocercops plebia*, larva of this moth causes discoloration of the leaves of Acacia. Coastal; *Phylacteophaga eucalypti*, Leaf Blister Sawfly, causes complete defoliation of young eucalypt seedlings, while growth of mature eucalypts may be seriously retarded. Coast and tablelands.

15526. **Hardy, D. E.** A New Dacus from Australia (Diptera: Tephritidæ). *Proc. Haw. Ent. Soc.*, xiv (1), March, 1950, 87–89, tfs. 1a–1f.—*Dacus* (*Strumeta*) *laticaudus* n.sp. Q.: Deeral.

15527. **Hardy, G. H.** How a Robber-fly (Dipt., Asilidæ) falls prey to a Scorpion-fly (Mecopt., Bittacidæ). *Ent. Mo. Mag.*, lxxxvi (1032), May, 1950, 146.—How common scorpion-fly of N.S.W., *Harpobittacus tillyardi*, E.P., can prey upon *Thereutria amaricus* Walk.

15528. **Harker, Janet E.** Australian Ephemeroptera. Part I. Taxonomy of New South Wales Species and Evaluation of Taxonomic Characters. *Proc. Linn. Soc. N.S.W.*, lxxv (1–2), 6 June, 1950, 1–34, tfs. 1–101.

15529. **Harris, W. B.** Control of Green Peach Aphis. *J. Dept. Agric. S.A.*, liii (10), May, 1950, 443–445, illustr.—*Myzus persicæ* L. (on peach and nectarine trees in S. Australia).

15530. **Helson, G. A. H.** Yellow Dwarf of Tobacco in Australia. V. Transmission by *Orosius argentatus* (Evans) to Some Alternative Host Plants. *Aust. J. Agric. Res.*, i (2), April, 1950, 144–147, pl.—Tobacco yellow dwarf virus disease was experimentally transmitted to 15 species of plants by *Orosius argentatus* (Evans). Eight of these plants are summer annuals and seven are autumn-spring growing plants which provide a continuous succession and wide range of hosts. Their occurrence in the districts where tobacco is grown makes control by the elimination of alternative host plants appear impracticable.

15531. **Hely, P. C.** The Value of D.D.T. in Tomato Pest Control Programmes. Central Coast Experiments. *Agric. Gaz. N.S.W.*, lx (9), Sept., 1949, 485–489.

15532. **Hely, P. C., and Levitt, E. C.** White Wax Scale Control on Citrus. Demonstration Plots in Central Coast Orchards. *Agric. Gaz. N.S.W.*, lxi (6), June, 1950, 307–310.

15533. **Heslop-Harrison, G.** A New Indo-Malayan Genus and Species of the Family Psyllidæ (Hemiptera-Homoptera). *Ent. Mo. Mag.*, lxxxv (1021), June, 1949, 161–164, tfs. 1–14.—*Neopsylla* g.n. Orthotype, *Psylla acaciæ* Maskell, 1894. Includes here also *Psylla* (*Psyllia*) *unctata* Ferris and Klyver, 1932 ; *P.* (*P.*) *unctatoides* Ferris and Klyver, 1932 ; *P.* (*P.*) *albizziæ* Ferris and Klyver, 1932.

15534. **Heslop-Harrison, G.** Contributions to our Knowledge of the Psyllidæ of Australia and New Zealand, with Special Reference to Tasmania. *Ann. Mag. Nat. Hist.*, (12) ii (21), Sept. (26 Oct., 1949), 641–660.—Gives a census of the Australian spp.

15535. **Heslop-Harrison, G.** The Aphalaran Genera, Aphalara Förster, Craspedolepta Enderlein and Metaphalara Crawford, with Special Reference to the European Species of Aphalara ; Hemiptera-Homoptera, Family Psyllidæ. *Ann. Mag. Nat. Hist.*, (12) ii (22), Oct. (4 Nov., 1949), 782–801, 2 tfs.

15536. **Heslop-Harrison, G.** Subfamily Separation in the Homopterous Psyllidæ. I. *Ann. Mag. Nat. Hist.*, (12) ii (22), Oct. (4 Nov., 1949), 802–810.

15537. **Hickman, V. V.** Tasmanian Littoral Spiders with Notes on their Respiratory Systems, Habits and Taxonomy. *Pap. Proc. R. Soc. Tasm.*, 1948 (issued separately 15 Sept., 1949), 31–43, tfs. 1–15.—Amourobioidæ new fam. *Amaurobioides* O. P. Cambr., note. *A. litoralis* sp.n. Agelenidæ : *Desis kenyonæ* Pocock, T. : Eaglehawk Neck, Adventure Bay, Bruni Island, at the Gardens ; Granelly Beach, River Tamar.

15538. **Hill, A. V.** Yellow Dwarf of Tobacco in Australia. IV. Some Host Plants of the Virus. *Aust. J. Agric. Res.*, i (2), April, 1950, 141–143, pl. 1.—Vector : *Orosius argentatus* (Evans, *Thamnotettix*).

15539. **Hincks, W. D.** Some Nomenclatorial Notes on Chrysomelidæ (Col.). No. 3. Cassidinæ. *Ann. Mag. Nat. Hist.*, (12) iii (30), June, 1950, 506–512.—*Austropsecadia* nom. nov. for *Psecadia* Weise, 1901, not Huebner, 1825 (Lepidoptera).

15540. **Hopkins, G. H. E.** The Host-Associations of the Lice of Mammals. *Proc. Zool. Soc. Lond.*, cxix (2), Aug., 1949, 387–604, 1 fig.

15541. **Hull, F. M.** The Morphology and Inter-relationship of the Genera of Syrphid Flies, Recent and Fossil. *Trans. Zool. Soc. Lond.*, xxvi (4), May, 1949, 257–408, tfs. 1–25.

15542. **Jakubski, A. W.** The First Margarodine (Tribe Margarodini) Coccid from Australia. *Ann. Mag. Nat. Hist.*, (12) iii (29), May, 1950, 397–413, tfs. 1–19.—*Eumargarodes* g.n. Orthotype, *E. laingi* sp.n. Q. : Bundaberg, Nov., 1938, R. W. Mungomery (adult females) ; J. H. Buzacott, May, 1939 (larvæ), all on the roots of sugar-cane.

15543. **Jenkins, C. F. H.** Some External Parasites of Sheep. *J. Dept. Agric. W.A.*, (2) xxvi (3), Sept., 1949, 235–242, illustr.—Red-headed Sheep Louse, *Damalinia ovis* Schr. ; the Foot Louse, *Linognathus pedalis* Osb. ; the Sheep Ked or " Tick ", *Melophagus ovinus* L.

15544. **Jenkins, C. F. H.** Modern Insecticides and Their Effects upon Bird Life. *Emu*, xlix (4), April, 1950, 272–281.

15545. **Johnston, A. N.** Studies on the Action of D.D.T. on Anopheline Mosquitoes and House-flies. *Bull. Ent. Res.*, xl (3), Dec., 1949, 447–452.—Experiments conducted at Cairns, N. Q'land, on *Anopheles* (*Myzomyia*) *punctulatus punctulatus* Don., and *Musca domestica* L.

15546. **Lallemand, V.** Revision des Cercopinæ (Hemiptera Homoptera). Première Partie. *Mem. Inst. R. Sci. nat. Belg.*, (2) xxxii, 1949, 1–193, pls. i-iv, tfs.—*Euryaulax arctofasciata* sp.n. N. Aust. : Burnside, Newcastle Waters.

15547. **Lee, D. J.** Sandfly Breeding Places. *Aust. J. Sci.*, xii (2), 21 Oct., 1949 (received at Australian Museum 18 April, 1950), 74–75.—Larvæ collected in the *Salicornia* zone lying between the mangroves and land, only covered by the highest spring tides, usually with a fringe of *Casuarina*. An undescribed species.

15548. **Lloyd, N. C.** The Pasture Scarab (*Aphodius howitti* Hope). A Pest in the Orange District. *Agric. Gaz. N.S.W.*, lx (8), Aug., 1949, 429–434, 446, illustr.

15549. **Lloyd, N. C.** The Cherry Aphid (*Myzus cerasi* Fab.) in the Orange District. *Agric. Gaz. N.S.W.*, lxi (2), Feb., 1950, 83–86, illustr.—Life-history, damage and control methods. (To be continued.)

15550. **Lloyd, N. C.** The Cherry Aphid (*Myzus cerasi* Fab.) in the Orange District. *Agric. Gaz. N.S.W.*, lxi (3), March, 1950, 149–152.

15551. **Lohrmann, E.** Neue Bembix-Arten des Wiener Natur-historischen Museums. *Ann. Nat. Mus. Wien*, lii, 1941 (May, 1942), 155–160, 2 tfs.—*Bembix promontorii* n.sp. Cape York, Q.; *B. octosetosa* n.sp. Rockhampton, Q.; *B. victoriensis* n.sp. Victoria; *B. brevis* n.sp. Cooktown, Q.

15552. **McArdie, A. A.** Red Mites—Hidden Enemy of Poultry. *J. Dept. Agric. S.A.*, liii (10), May, 1950, 451.

15553. **McKeown, K. C.** Australian Insects. XXXVII. Coleoptera 14—The Auger Beetles. *Aust. Mus. Mag.*, ix (12), July-Sept. (Sept. 30= Dec. 2, 1949), 407–410, illustr.

15554. **McKeown, K. C.** Australian Insects. XXXIX. Coleoptera 16—Ladybirds. *Aust. Mus. Mag.*, x (2), March 31 (=July 4, 1950), 65–67, illustr.

15555. **McMillan, R. P.** A Jewel Beetle of the Flooded Gum (*Melobasis sexplagiata*). *W. Aust. Nat.*, ii (3), Jan. 24, 1950, 57–58, fig.

15556. **Marks, Elizabeth N.** Studies of Queensland Mosquitoes. Part IV. Some Species of *Aëdes* (Subgenus *Ochlerotatus*). *Univ. Q'ld. Pap. Dept. Biol.*, ii (11), 30 Sept., 1949, 1–41, tfs. 1–16.—*A.* (*O.*) *aculeatus* (Theob.), S. coastal Queensland locs. N.S.W.: Port Macquarie. (*A.* (*O.*) *theobaldi* (Taylor), inland species. Also recorded from coastal areas in south-east Queensland. Recorded from N.S.W., V., S.A., gives additional locs. from Q., N.S.W. *A.* (*O.*) near *theobaldi*, larva, Condamine, Q. *A.* (*O.*) *normanensis* (Taylor), Q.: locs.; N.T.: locs. *A.* (*O.*) *pseudonormanensis* n.sp. Eidsvold, Q. (types), syn. *A.* (*O.*) *normanensis* Mackerras, 1927, nec. Taylor. *A.* (*O.*) *perkinsi* n.sp. Known only from type loc., a heath swamp about five miles from Caloundra, S.Q. *A.* (*O.*) *stricklandi* (Edwards), W.A.: locs.; S.A.: Mt. Compass; Bass. Strait: Flinders Is.; V.: Lower Tarwin.

15557. **Marks, Elizabeth N.** Note on the Mosquito Fauna of the Dunwich Area. *Q'land Nat.*, xiv (1), Nov., 1949, 9–12.

15558. **Mathews, Wallace H.** Notes on the Ant-Lions of the Sub-Family Myrmeleontinæ. *W. Aust. Nat.*, ii (3), Jan. 24, 1950, 64–66, tfs. 1–4.—Refers to four spp. of *Acanthoclisis*: *A.* sp.; *A. subfasciata*; *A. fundata*; *A. subtendens*. All from S. Perth, W.A.

15559. **Maunder, J. C. J.** Cattle Tick Control: Results Achieved in the Field with D.D.T. and B.H.C. *Q'land Agric. J.*, lxix (3), Sept., 1949, 160–167.

15560. **May, A. W. S.** The Mite Problem at Stanthorpe. *Q'land Agric. J.*, lxviii (5), May, 273–274.—Red Spider; Bryobia; Eriophyid mite. Reprinted as *Advisory Leaflet* No. 155.

15561. **Miller, N. C. E.** New Genera and Species of Dulitocorini (Reduviidæ-Stenopodinæ). *Ann. Mag. Nat. Hist.*, (12) ii (21), Sept. (26 Oct., 1949), 687–703, tfs. 1–10.—Key to genera. Key to spp. of *Pedionotocoris*. *Dulitocoris usingeri* sp.n. Q.: Mackay.

15562. **Mills, M. B.** Observations on Processionary Caterpillars. *Ochrogaster contraria* Walk. *W. Aust. Nat.*, ii (4), May 17, 1950, 84–87.

15563. **Morgan, W. L.** Control of Insect Pests of Tobacco. New Insecticides Tested. *Agric. Gaz. N.S.W.*, lx (10), Oct., 1949, 536–538, 556.

15564. **Mouchamps, R.** Contribution à la systématique des Coléoptères Gyrinides. I. *Dineutus* (*Spinosodineutus*) Hatch. *Bull. Ann. Soc. Ent. Belg.*, lxxxv (9–10), 10 Nov., 1949, 216–264, pls. 1–5, 2 maps.

15565. **Mungomery, R. W.** Report of the Division of Entomology and Pathology. *49th Ann. Rpt. Bur. Sugar Exp. Stat.*, Brisbane, pp. 36–39, figs. 6–8 (1949).—The Greyback Cane Beetle, *Dermolepida albohirtum*, control by "Gammexane" (benzene hexachloride). "Frenchi" beetles, *Lepidiota frenchi* Blkb., control by benz. hexach. *Pseudoholophylla furfuracea* Burm.; *Lepidiota consobrina* Lea. Wireworms *Lacon variabilis* Cand., control by B.H.C. *Rhabdoscelus obscurus* Boisd., weevil borer of cane—control by burning cane. *Aphænogaster pythia* Forel, mound-building ant, at Tully. *Margarodes* sp.; the Sugar-cane Scale, *Aulacaspis madiunensis* Zehnt.

15566. **Musgrave, A.** Spiders Harmful to Man. II. *Aust. Mus. Mag.*, ix (12), July-Sept. (Sept. 30= Dec. 2, 1949), 411–419, illustr.—Records those species of Australian spiders whose bites have caused suffering or inconvenience to man, while mention is also made of harmful exotic forms.

15567. **Neave, S. A.** Nomenclator Zoologicus. 8vo. London. Vol. v (1936–1945), pp. 308.

15568. **Nichols, L. E., and Weddell, J. A.** The Control of Mites at Cheese Factories and Cold Stores. *Q'land Agric. J.*, lxx (4), April, 1950, 220–225, pls. 109–111.

15569. **Norris, K. R., Roulston, W. J., and Snowball, G. J.** Observations on the Control of the Cattle Tick with Preparations of D.D.T. and Benzene Hexachloride (B.H.C.) in Dips. *Aust. J. Agric. Res.*, i (2), April, 1950, 165–177.

15570. **Paramonov, S. J.** Notes on Australian Diptera (I-V). *Ann. Mag. Nat. Hist.*, (12) iii (30), June, 1950, 515–534.—Paper in five sections as follows: I. The Localities referred to by Macquart as "Cap des Aiguilles"; "Isle Sydney", and "Océnaie". II. A Review of the Genus *Amphibolia* Macq. (Tachinidæ). Key to spp. *A. valentina* Macq., Tasm., V., N.S.W., W.A. locs.; *A. ignorata* sp.n. N.S.W., V., S.A. locs. *A. campbelli* sp.n. N.S.W. locs. *A. wilsoni* sp.n. V.: Warburton. *A. albocincta* Mall. N.S.W.: Barrington Tops. III. A Note on Two New Australian Therevids. *Mannia* g.n. Key to genera and spp. Orthotype, *M. tasmanica* sp.n. T.: Tyenna. *Eupsilocephala singula* Walk. W.A. locs. *E. kröberi* sp.n. Q.: Eidsvold. IV. A Review of Australian Species of the Genus *Antonia* (Bombyliidæ). Key to spp. *A. roddi* sp.n. N.S.W.: Lane Cove near Sydney. *A. decorata* sp.n. ? loc. *A. hermanni* Beck., descr. ♂. V. On So-called *Syrphus viridiceps* Macq. (Syrphidæ). *Xanthogramma* sp.

15571. **Pasfield, G., and Braithwaite, B. M.** The Argentine Ant (*Iridomyrmex humilis* Mayr.). *Agric. Gaz. N.S.W.*, lxi (7), July, 1950, 335–340, illustr.—Records this species from the Sydney metropolitan area. Gives description and life-history of species and control.

15572. **Perkins, F. A., and May, A. W. S.** Studies in Australian and Oriental Trypetidæ. Part IV. New Species of Dacinæ from Queensland. *Univ. Q'land Dept. Biol.*, ii (14), 28 Nov., 1949, 1–21, tfs. 1–10.—*Strumeta manskii* n.sp. Q.: Cairns, bred from *Strychnos bancroftiana* Bail. *S. fuscatus* n.sp. Q.: Cairns, bred from *Sideroxylon obovatum*. *S. bilineata* n.sp. Q.: Cairns, bred from *Sideroxylon obovatum* (R.Br.). *S. endiandræ* n.sp. Q.: Cairns, bred from *Endiandra discolor* Benth.; Cairns, bred from *Cryptocarya erythroxylon* Maiden and Betche; Mossman, same host. *S. pallidus* n.sp. Q.: Cairns, bred from fruits of *Sarcocephalus cordatus* Mig.; Brisbane, same host. *S. melas* n.sp. Q.: Gayndah, Nambour and Palmwoods, bred from grapefruit. *S. solani* n.sp. Syn. *Chætodacus dorsalis* Tryon nec. Hendel, southern Q'land, from fruits of *Solanum auriculatum* Ait. and *S. verbascifolium* Ait. (Wild Tobacco). Occasionally from tomatoes. *Asiadacus* F.A.P., 1937, not previously recorded from Australia. *A. calophylli* n.sp. Q.: Cairns, bred from fruits of *Calophyllum inophyllum* L. *Afrodacus* Bezzi, 1924: two species have previously been recorded, *A. biguttulus* Bezz. from Africa, and *A. jarvisi* Tryon from Q'land. *A. brunneus* n.sp. Q.: Gayndah and Stanthorpe, trapped in a citrus and deciduous fruit orchard. *Daculus* Speis., 1924. This genus has not previously been recorded from Australia. A series of specimens considered to be conspecific with *Daculus murrayi* F.A.P. were bred from fruits of *Semecarpus australiensis* Engel. *Zeugodacus* Hendel, 1927. A series of specimens bred from the fruits of *Hearnia sapindina* F.v.M. in August, 1937, have been identified as *Zeugodacus atrisetosus* F.A.P., which was described from specimens collected in New Guinea.

15573. **Powning, R. F.** The Compatibility of D.D.T. with Nicotine and Alkaline Diluents in Agricultural Dusts. *Aust. J. Agric. Res.*, i (2), April, 1950, 178–181.—Points out that a combined dust consisting of D.D.T. and nicotine in pyrophyllite, calcium carbonate, or magnesium carbonate is sufficiently stable for use against cabbage insects and may be stored safely for at least two months.

15574. **Priesner, H.** Genera Thysanopterorum. Keys for the Identification of the Genera of the Order Thysanoptera. *Bull. Soc. Fouad ler Entom.*, xxxiii (31 Dec., 1949), 31–157.

15575. **Rayment, T.** Mites, "French Moult", and Bees. *Vict. Nat.*, lxvi (6), Oct., 1949, 118–119, fig.—Records mites from Australian bees: *Tyroplyphus* near *farinæ* from *Saropoda*; *Tyrofagus tenuiclavus* from nest of *Exoneura*.

15576. **Rayment, T.** New Bees and Wasps. Part XII. *Vict. Nat.*, lxvi (8), Dec., 1949, 147–151, tfs. i-ii.—*Euryglossimorpha aureomaculata* sp.n. N.S.W.: Mt. Keira. Found in association with *Coptotermes lacteus* Frogg. *Callomelitta picta perpicta* Ckll., found in association with termite, *Stolotermes victoriensis* Hill, from Victoria.

15577. **Rayment, T.** A New and Remarkable Organ on a Resin-Bee. *Vict. Nat.*, lxvi (9), Jan., 1950, 163–168, tfs. 1–27.—*Megachile remeata* Ckll., description of allotype. W.A.: Bolgart.

15578. **Rayment, T.** Sex-Linked Characters in Bees. *Vict. Nat.*, lxvi (12), April, 1950, 233–238, illustr.

15579. **Rayment, T.** New Bees and Wasps. Part XIII. *Analastoroides*, A New Genus of Wasp-like Bees. *Vict. Nat.*, lxvii (2), June, 1950, 20–25, pl. (20 figs.).—Hylæidæ, Hylæoidinæ: *Analastoroides* n.g. Orthotype, *A. foveata* sp.n. N.S.W.: Jamberoo.

15580. **Remy, P.** Sur quelques Pauropodes d'Australie. (Recoltes de M. le Professeur O. W. Tiegs.) *Mem. Nat. Mus. Vict.*, xvi (Dec., 1949), 51–58, tf. 1.—*Stylopauropus Tiegsi* n.sp. V.: Belgrave; *Pauropus silvaticus* Tiegs. T.: Belgrave.

15581. **Roberts, F. H. S.** The Distribution and Seasonal Prevalence of Anopheline Mosquitoes in North Queensland. *Proc. R. Soc. Q'land*, 1947, lix (2), 20 Dec., 1948, No. 2 (issued separately 16 Aug., 1948), 93–100.

15582. **Roewer, C. F.** Einige neue Arachniden. I. *Veroff. Deutsch. Kol.-u. Uebersee-Mus. Bremen*, iii (3), 20 Nov., 1942, 277–280, pl. 20, f. 1–6.—Opiliones: Triænonychidæ, Triænonychinæ: *Yatala* g.n. Haplotype, *Y. hirsti* sp.n. S.A.: Yatala. *Callihamina* g.n. Haplotype, *C. adelaidia* sp.n. S.A.: Adelaide.

15583. **Roewer, C. F.** Uber Phalangodiden I. (Subfam. Phalangodinæ, Tricommatinæ, Samoinæ, Weitere Weberknechte XIII). *Senkenbergiana*, Frankfurt am Main, xxx (1–3), 31 May, 1949, 11–61, tfs. 1–14.—*Spalicus* n.g. Orthotype, *S. œditarsus* sp.n. Blue Mts. *Badessania* n.g. Orthotype, *B. metatarsalis* sp.n. Blue Mts.

15584. **Schedl, K. E.** Tropical Seed Beetles of the Genus *Coccotrypes* Eichh. 99. Contribution to the Morphology and Toxonomy of the Scolytoidea. *Tijdsch. v. Ent.*, xci, 1948 (Dec. 20, 1949), 113–120 illustr.—*C. carpophagus* Horn, Australia; extra limital. *C. pilosulus* n.sp. Q.: Kuranda.

15585. **Schedl, K. E.** Scolytidæ and Platypodidæ. Contribution 86. New Species and New Records of Australian Scolytidæ. *Proc. R. Soc. Q'land* for 1948, lx, No. 2, issued separately 24 Nov., 1949; vol. issued 20 Jan., 1950, 25–29, tf. 1.—*Cryphalus asperulus* sp.n. Q.: Imbil, ex *Grevillea robusta*. *C. brimblecombei* sp.n. Q.: Emu Vale, ex *Cryptocarya erythroxylon*. *Hypocryphalus nigrosetosus* sp.n. Q.: Kalpowar, from rain forest tree, ? *Capparis nobilis*. *Xyleborus pseudoangustatus* sp.n. Q.: Stapleton, ex *Eucalyptus maculata*, Brookfield, ex loquat; Stanthorpe, ex apple and plum. N.S.W.: West Pennant Hills, ex apple-wood.

15586. **Snyder, T. E.** Catalog of the Termites (Isoptera) of the World. *Smithson. Misc. Coll.*, cxii, Nov. 1, 1949, 1–490.

15587. **Steel, W. O.** Notes on the Omaliinæ (Col. Staphylinidæ). *Ent. Mo. Mag.*, lxxxv (1024), Sept., 1949, 231–240, tfs. 1–23.—*Austrolophrum* Steel, 1938. Genotype, *A. cribriceps* (Fauvel, 1878). N.S.W., V., T., S.A., W.A. *A. cribriceps* var. *guichardi* nov. V.: Mt. Martha. *A. australe* (Fauvel, 1877). Sydney. *Leaskia* Steel, 1938, def.

15588. **Steel, W. O.** Notes on the Omaliinæ (Col. Staphylinidæ). *Ent. Mo. Mag.*, lxxxv (1025), Oct., 1949, 241–245, tfs. 24–38.—*Leaskia acidoti-*

formis Steel, 1938. Vict.: Wannon Valley, Major Mitchell's Plateau. *L. spinipes* (Fauvel), 1878. W.A.: Fremantle.

15589. **Thompson, G. B.** A List of the Type-hosts of the Mallophaga and the Lice Described from Them. *Ann. Mag. Nat. Hist.*, (12) iii (28), April, 1950, 269–287.

15590. **Thompson, G. B.** A List of the Type-hosts of the Mallophaga and the Lice Described from Them. *Ann. Mag. Nat. Hist.*, (12) iii (29), May, 1950, 365–382.

15591. **Tiegs, O. W.** Presidential Address. The Problem of the Origin of Insects. *Rpt. 27th Meeting A. N.Z. Ass. Adv. Sci.*, Hobart, Jan., 1949 (1950), 47–56, tfs. 1–4.

15592. **Toop, C. R.** Lice and Tick in Sheep. *J. Dept. Agric. W.A.*, (2) xxvi (3), Sept., 1949, 226–230, illustr.

15593. **Uhmann, E.** Hispinæ aus dem Britischen Museum. V. Teil. 129. Beitrag zur Kenntnis der Hispinæ (Coleopt., Chrysom.). *Ann. Mag. Nat. Hist.*, (12) iii (28), April, 1950, 324–337, tfs. 1–4.—*Hispellinus germari* (Chapuis), 1877. W.A.: Yanchep, 32 miles north of Perth.

15594. **Wason, E. J., and Lloyd, N. C.** Insect Pests. Pests of Pome Fruit Trees. *Agric. Gaz. N.S.W.*, lx (9), Sept., 1949, 479–483, illustr.—Pests of pome fruit trees: Codling Moth, control by D.D.T. 0·1%; lead arsenate. Red Mite, control. Red Spider, control. Woolly Aphid, control. Light Brown Apple Moth, control. Cutworms (Noctuidæ), control. The Vegetable Weevil, *Listroderes obliquus*.

15595. **Waterhouse, D. F.** The Hydrogen Ion Concentration in the Alimentary Canal of Larval and Adult Lepidoptera. *Aust. J. Sci. Res.*, ii (4), Nov., 1949, 428–437.

15596. **Womersley, H.** On the Female of the Dipteron *Scatopse aptera* Womersley, 1942. *Rec. S. Aust. Mus.*, ix (3), June 30, 1950, 331–338, tf. 1.—*See* Womersley, *Trans. R. Soc. S.A.*, lxvi (1), 1942, 74. Describes allotype female from Tapanappa, near Cape Jervis, S.A.

15597. **Woodhill, A. R.** A New Subspecies of *Aëdes (Stegomyia) scutellaris* Walker (Diptera, Culicidæ) from Northern Australia. *Proc. Linn. Soc. N.S.W.*, 1949, lxxiv (3–4), 21 Oct., 1949, 140–144, tfs. 1–4.—*Aëdes scutellaris scutellaris* Walker, 1859, additional records, New Britain; New Guinea; Morotai. *A. scutellaris katherinensis* n. subsp. N.A.: Batchelor, Katherine (type loc.). W.A.: Kummunya Mission, Port George iv, Kimberley Division.

15598. **Woodhill, A. R.** A Note on the Experimental Crossing of *Aedes (Stegomyia) scutellaris scutellaris* Walker and *Aedes (Stegomyia) scutellaris katherinensis* Woodhill (Diptera, Culicidæ). *Proc. Linn. Soc. N.S.W.*, lxxiv (5–6), 15 Dec., 1949, 224–226, 1 tf.

15599. **Wygodzinsky, P.** "Reduvioidea" from New South Wales. Description of a Remarkable new Genus and Species of "Emesinæ" (Reduviidæ, Hemiptera). *Rev. Brasil. Biol.*, ix (2), 1949, 217–222, tfs. 1–19.—*Armstrongocoris* n.g. Orthotype, *A. singularis* n.sp. N.S.W.: Acacia Plateau. Type Aust. Mus.

15600. **Wygodzinsky, P.** Reduvioidea from New South Wales. Notes and Descriptions. *Proc. Linn. Soc. N.S.W.*, lxxv (1–2), June, 1950, 81–88, tfs. 1–34.—Fam. Enicocephalidæ: *Usingeriella* g.n. Orthotype, *U. boganensis* sp.n. N.S.W.: Bogan River. Type in Aust. Mus. Fam. Reduviidæ. Subfam. Emesinæ. *Empicoris rubromaculatus* (Blackb., 1889). N.S.W.: Bogan River, Acacia Plateau. *Armstrongula* g.n. Orthotype, *A. tillyardi* sp.n. N.S.W.: Bogan River. Subfamily Holoptilinæ: *Ptilocnemus lemur* Wwd., 1840. N.S.W.: Bogan River, Inverell. Subfamily Stenopodinæ: *Sastrapada australica* Stal, 1874. N.S.W.: Acacia Plateau. Subfamily Reduviinæ: *Archilestidium ornatulum* Breddin, 1900. N.S.W.: Acacia Plateau. Subfamily Harpactorinæ: *Endochus (Pnirsus) cinctipes* Stal. N.S.W.: Inverell. *Nyllius* Stal, 1859, syn. *Orgetorixa* China, 1925. *N. australicus* (China, 1925). N.S.W.: Acacia Plateau.

15601. **Zeck, E. H.** Presidential Address. Some Insect Pests of Animals. *Proc. R. Zool. Soc. N.S.W.*, 1948–49 (May, 1950), 7–15.

BOTANY.

Hon. Abstractor: J. W. Vickery.

15602. **Aellen, P.** Revision der australischen und neuseelandischen Chenopodiaceen. III. *Atriplex* (2. Nachtrag). *Candollea*, xii (1949), 153–155.—One new species, *Atriplex cephalantha*, is described from Western Australia, and a new name, *A. Eardleyi*, is established.

15603. **Barnard, C.** Microsporogenesis, Macrosporogenesis, and Development of the Macrogametophyte and Seeds of *Duboisia Leichhardtii* (F.v.M.) and *D. myoporoides* (R.Br.). *Austral. Journ. Sci. Res.*, ii (3), 1949, 241–248.—The haploid number of chromosomes in both species is 30. Macrosporogenesis, development of the embryo sac and embryogeny is comparable to published descriptions for other genera of the Solanaceæ except for the development of the endosperm. A primary endosperm of large thin-walled cells is present until the ovules have almost reached mature seed size and the embryo at the 14-celled stage. Meristematic activity in the vicinity of the embryo then results in the formation of a dense secondary endosperm the cells of which become filled with oil. Emptiness of the seed is probably caused primarily by lack of fertilisation, but degeneration of the ovules may occur at almost any stage of development.

15604. **Cleland, J. B.** Additions to the Flora of the Adelaide Coast. *South Austral. Nat.*, xxv (2, 3, 4), 1950, 26–27.—This contains additions to the list issued in 1935, and brings the total number of species recorded for the coast district to 530.

15605. **Coleman, Edith.** Further Notes on the Mistletoe. *Vict. Nat.*, lxvi (10), 1950. 191–194.—Notes on behaviour of the Mistletoe bird in its relationship to distribution of the seeds of Mistletoes.

15606. **Cross, D. O., and Vickery, Joyce W.** List of the Naturalised Grasses in New South Wales. *Contrib. N.S.W. Nat. Herb.*, i (5), 1950, 275–280.

15607. **Ford, Neridah, and Vickery, Joyce W.** The Correct Name of Sturt's Desert Pea, *Clianthus formosus* (G. Don.) comb. nov. *Contrib. N.S.W. Nat. Herb.*, i (5), 1950, 302–303.—A nomenclatural study.

15608. **Gardner, C. A., and Watson, E. M.** The Western Australian Varieties of *Eucalyptus oleosa* F. Muell. ex Miq. and Their Essential Oils. *Journ. Roy. Soc. W.A.*, xxxiv for 1947–48, 1950, 73–86.—The history of *E. oleosa* is discussed, and six varieties are recognized, of which four are here described as new.

15609. **Gilbert, L. A.** Naturalist-Explorers of the Australian Coasts. *Vict. Nat.*, lxvii (3), 1950, 49–53.

15610. **Hart, T. S.** Heterophylly in the Prickfoot (*Eryngium vesiculosum*). *Vict. Nat.*, lxvi (10), 1950, 197.—Leaves found representing early season growth are hollow, subulate, and several inches long in contrast to the coarsely serrated narrow blades developed later.

15611. **Herbert, D. A.** Present Day Distribution and the Geological Past. *Vict. Nat.*, lxvi (12), 1950, 227–232.—The present vegetation of Australia is a mosaic of types that have been sifted out by climate and soil and profoundly influenced in their detailed composition by the geological past. Some elements are assumed to have invaded the continent, but there is a strongly developed element peculiar to Australia. The significance of climatic barriers and of land bridges determining the present plant communities is discussed.

15612. **Hubbard, C. E.** *Henrardia*, a New Genus of the Gramineæ. Blumea, Suppl. iii, 1946, 10–21.—The affinities of the genera *Henrardia, Lepturus, Monerma, Parapholis* and *Pholiurus* are discussed and their morphological characters delineated. Several of the species affected by this revision of generic limits are naturalized in Australia.

15613. **Learmonth, N. F.** Monthly Notes from Portland F.N.C. *Vict. Nat.*, lxvi (10), 1950, 198.—Additions to the plant list of the Lower Glenelg National Forest are recorded.

15614. **Lewis, N.** The Acacias of the Adelaide Hills. *South Austral. Nat.*, xxv (2, 3, 4), 1950, 14–20.—The morphological characters of the species of *Acacia* found in the district are discussed, and a key is provided to enable identification.

15615. **Lucas, A. H. S., and Perrin, Florence.** The Seaweeds of South Australia. Part II. The Red Seaweeds. Adelaide, 1947, pp. 116–458.—This is a handbook of the red seaweeds, mainly Rhodophyceæ, known from the coasts of South Australia, with descriptions and locality records. Many species are illustrated. The first part of the work was prepared by A. H. S. Lucas prior to his death in 1936, and the remainder was completed by Mrs. Perrin. The system of classification used is that of De Toni "Sylloge Algarum" 1889–1924, which has a morphological and in some measure an artificial basis. In view of recent trends towards a more natural classification based on studies of life histories, appendices reviewing the classifications of the Green, Brown and Red Algæ have been provided by H. M. S. Womersley and J. R. Harris. The former author has also added numerous species, descriptions and keys which were not included by the primary authors.

15616. **Mort, G. W.** Vegetation Survey of the Marine Sand Drifts of New South Wales. Some Remarks on Useful Stabilising Species. *Journ. Soil Conserv. Service N.S.W.*, vi (2), 1950, 63–72.—Marram Grass (*Ammophila arenaria*) and Sand Spinifex (*Spinifex hirsutus*) are considered in relation to their habit and biology, and their utility in controlling drift of coastal sand dunes.

15617. **Nicholls, W. H.** Additions to the Orchidaceæ of Australia. I. *Vict. Nat.*, lxvi (11), 1950, 211–215.—*Diuris citrina* from N.S.W., *Prasophyllum appendiculatum* from Victoria, *Caladenia Ericksonæ* and *Pterostylis rufa* R.Br. var. *despectans* from Victoria are described as new and figured.

15618. **Nicholls, W. H.** *Pterostylis furcata*. An Additional Note. *Vict. Nat.*, lxvi (12), 1950, 239–240.—Further records of this species in Tasmania.

15619. **Nicholls, W. H.** Additions to the Orchidaceæ of Australia. II. *Vict. Nat.*, lxvi (12), 1950, 223–226.—*Caladenia variabilis* and *Dendrobium fusiforme* Bail. var. *Blackburnii* are described as new and figured. Robust specimens of *Caladenia longiclavata* Coleman from S.W. Australia are noted, and *Thelymitra retecta* Rupp is recorded from eastern Victoria.

15620. **Nicholls, W. H.** The Genus *Phaius* in Australia. *Vict. Nat.*, lxvii (1), 1950, 10–15.—Notes on the systematics and distribution of the species.

15621. **Nicholls, W. H.** Additions to the Orchidaceæ of Australia. III. (Two New Species of *Pterostylis* in Victoria.) *Vict. Nat.*, lxvii (3), 1950, 45–48.—*Pterostylis Fischii* and *P. tenuissima* are described and figured.

15622. **Pryor, L. D.** A Hybrid *Eucalyptus*. *Proc. Linn. Soc. N.S.W.*, lxxv (1–2), 1950, 96–98.—Evidence from field occurrence, morphological affinities and open-pollinated progeny tests is put forward which indicates that plants previously referred to *Eucalyptus vitrea* are naturally-occurring hybrids between *E. pauciflora* and *E. dives*.

15623. **Rupp, H. M. R.** The Schlechter Collection of Orchidaceæ in the National Herbarium of New South Wales. *Contrib. N.S.W. Nat. Herb.*, i (5), 1950, 304–311.—The National Herbarium of N.S.W. possesses nearly 400 duplicates of Schlechter's orchid collections, and these are here listed. The greater part of his herbarium was housed in the Berlin Museum, and may have been damaged during the 1939–45 war. The species are listed under their country of origin, viz. New Guinea, New Caledonia, Celebes and Borneo, Sumatra, South Africa.

about 15,000 bird skins, 1000 mammals, a rich collection of insects (especially butterflies), representative molluscs, fish (in spirit and as casts), reptiles, and a moderate collection of other groups. Living animals include six orang utans, and there is an extensive plant collection. Specimens are mostly from Sarawak, but they include material from North and East Borneo (especially ethnographic).

Expeditions to Sarawak are given travel facilities and other indispensable aid by the Government, on terms of a share of the collections acquired. The Museum establishment includes the Curator and Assistant Curator, Archivist, Research Assistant, two taxidermists, two collectors and a Photographer. Facilities are offered to visiting scientists. Sarawak is almost without road communications and there is no hotel in Kuching, the capital city. The Museum was a special interest of the Brooke family. Until research space is extended by a building to be erected in 1951, visiting scientists must be prepared for somewhat rough conditions.

The *Sarawak Museum Journal* is published at least once a year, and otherwise as opportunity permits. The subscription is six Straits dollars. Although a large proportion of space is devoted to anthropology, ethnology and archaeology, contributions are also published from zoology, botany, meteorology, geology, and other fields.

Parsons Memorial Window

On 5 October the Dean of Westminster dedicated in the Abbey a Memorial Window, designed by Sir Ninian Comper, to commemorate Sir Charles Parsons, O.M., F.R.S.

Sir Charles Parsons was born in 1854 and after his death in 1931 the Royal Society set up a committee to arrange an appropriate memorial, of which the Window in Westminster Abbey is one outcome. Another is the Parsons Memorial Lecture delivered annually. A third was the contribution of £10,000 towards the Parsons Memorial Library at London House, Bloomsbury, which was opened by Her Majesty Queen Mary in 1937. Sir Frank Smith, Chairman of the Royal Society Committee and himself the first Parsons Memorial Lecturer, delivered the Memorial Oration at the Abbey.

Vacuum Oil Company Scholarships

For research in the fields of chemistry, chemical engineering, mechanical engineering, or mining engineering, scholarships worth £500 a year have been made available at the Universities of Melbourne and Sydney by the Vacuum Oil Company Pty. Ltd. The intention is to assist Australian universities in developing research workers who are not only outstanding in particular fields of research but have the potential all-round ability to assume executive responsibility in industry. It is desired to select men with potential all-round ability rather than purely academic outlook.

The Vacuum Oil Company Research Scholarships will be open to engineering and science graduates of any university in Australia, but research work under the scholarships is to be carried out at either Melbourne or Sydney. The scholarships will be awarded each year from applications lodged with the Registrar of either university. Selection of scholarship winners will be made by the Professorial Board of each university, on the recommendation of a committee consisting of the appropriate heads of departments and a representative of the Vacuum Oil Company Pty. Ltd. Scholarship holders will have the usual right to publish the results of their research.

Research Fellowships in Canada

The National Research Council of Canada will award thirty-four Fellowships in Pure Chemistry and Physics, tenable in their laboratories at Ottawa in 1951-1952. Fellowships may be renewed for a second year on application. Applicants are, as a rule, expected to have a Ph.D. degree. The allowance is $2820 a year, with travelling allowances from abroad. Applications (on a special form) should reach the Secretary, Laboratory Awards Committee, N.R.C., Ottawa, by 15 February 1951.

Genetical Survey of Human Populations in Pacific Area

Since 1944 Mr. Roy T. Simmons, of the Commonwealth Serum Laboratory, Parkville, Vic., and his colleagues, have tested and published genetical analyses of blood samples from aboriginal groups in Australia, Fiji, New Caledonia and nearby islands, Admiralty Islands, southern coastal New Guinea, Leyte, and New Zealand. Additional data have been available on Japanese, Hollanders, and various Indonesian groups. Work is continuing on samples received from the Gilbert Islands, five populations in Borneo, and two provinces in China; arrangements have been made to receive blood and saliva samples from the Mt. Hagen region of New Guinea and from areas in the United States Trust Territory of the Pacific Islands. Co-operating in this project are the Department of Anthropology and Sociology of the University of California at Los Angeles, the Pacific Science Board of the National Research Council, Washington, D.C., and the U.S. Navy. It is hoped that the results of the survey will contribute to knowledge of basic racial populations in the Pacific, the degree of hybridization, the rates of gene flow, the process of genetic drift, and, ultimately, to the methods for investigating the influence of natural selection on serological antigens. An account of this project, by Joseph B. Birdsell, is published in *Science*, *112*, 7 July 1950.

National Institute of Oceanography

The provisional Executive Committee of the *National Institute of Oceanography* approved that the work of the Institute (which has headquarters at 137 Queen Anne's Mansions, London) should be directed to such fundamental problems as those outlined in the Recommendations for research made at the Seventh Pacific Science Congress. The study of waves and swell is being extended to include all effects of wind on the sea and a theoretical and experimental study of the interchange of heat and water vapour between the sea and air. Information about deep water circulation will be obtained by the Institute's research vessels, but the primary object will be to make such studies of the physical processes as will allow a more precise interpretation of existing data and future observations. The Royal Research Ship *Discovery II* is making observations across the southern part of the Pacific Ocean and will make observations near New Zealand in co-operation with the New Zealand Inter-Departmental Committee on Oceanography. The ship is using echo and seismic sounding apparatus to study bottom topography, and the Kullenberg corer to study the sediments. The Royal Research Ship *William Scoresby* will make a contribution to the study of supply of nutrient salts to the photosynthetic zone by observations in regions of upwelling off the west coast of Africa and north-west coast of Australia for comparison with those made in 1931 in the Peru current. The continued investigation of the longitudinal circulation of water in different sectors of the Southern Ocean will give further information on the transfer of nutrient salts and the problem of the maintenance of the plankton population over an oceanic shoal area. Detailed observations on the mixing and transfer of water from one layer to another will be made using equipment similar to that employed by Spilhaus and Miller off the east coast of the United States.

Conservation of Museum Objects

The Secretary-General of the newly-formed International Institute for the Conservation of Museum Objects (F. I. G. Rawlings) advises that the objects of the Institute are the provision of a permanent international organization to co-ordinate and improve the knowledge, methods, and working standards needed to protect and conserve all kinds of precious material; research into and development of all appropriate processes; publication of a periodical; maintenance of a high standard of professional competence; inauguration of training schemes. The address of the Institute is: 1, Montague Place, Bedford Square, London, W.C.1.

Protection of Nature

The Seventh Pacific Science Congress congratulated New Zealand on the prompt measures taken to protect the rediscovered *Notornis hochstetteri*. It is now reported that the rediscovery of a small colony of the primitive frog *Liopelma hamiltoni* on Stephen's Island in Cook Strait was immediately followed by arrangements for fencing to prevent stock grazing, and an enquiry into the possibility of improving dampness in the area in periods of drought. The frogs are afforded absolute protection under the Animals Protection and Game Act.

British Food Fair

The British Food Fair at Olympia, 29 August to 9 September, included a series of stands in which the D.S.I.R. showed various applications of scientific research. The Ditton Laboratory showed both a cold store and a gas store for apples. Cold storage in air, which is liable to kill the apple if the temperature falls below 37°F, will keep English apples in good condition for only six months, and therefore does not cover the year between harvests. Gas storage uses the carbon dioxide which is the product of the respiration of the fruit itself; it increases the storage life at any temperature by about two-thirds. (D.S.I.R. Food Investigation Leaflet No. 6, *The Refrigerated Gas Storage of Apples*, revised 1950. 6*d*.)

The Torry Research Station showed methods of freezing and of smoke-curing fish. Most of the catch brought to Britain is nowadays from distant fishing grounds and may be twenty days old before being eaten. This requires freezing aboard the fishing vessel at temperatures between −23° and −29°C.

The Low Temperature Research Station, the Hannah Dairy Research Institute and the National Institute for Research in Dairying together showed methods of drying milk. The best-keeping milk powder is obtained by drying on hot rollers, but it needs warm water to be reconstituted. Milk which is dried by spraying in hot air after precondensation is easily reconstituted in cold water, but had poor keeping qualities. It developed a tallowy flavour due to the action of oxygen in the air in the tin upon the fat in the milk; this has been overcome by the use of an inert gas such as nitrogen in the packing. Stale flavours and loss of solubility were also produced by a reaction between the protein and the sugar in the milk; these disadvantages have been minimized by drying the powder more completely and by storing at low temperature.

Pelagic Fish

Data on the geographical distribution and seasonal fluctuations of surface-swimming fish in south-eastern Australian waters have been collected over the past ten years by the C.S.I.R.O. Division of Fisheries and its collaborators. These data were drawn from aerial reconnaissance, observations from the shore, surveys from various types of fishing craft and other boats, the activity of diving birds, catches made by nets, and so on. The fish are confined almost exclusively to the narrow band of water

within the continental shelf, which on the east coast is little more than twenty miles wide. The C.S.I.R.O. reports progress made in the development of pelagic fishery and indicates lines along which success may most probably be achieved. The basis of the industry may be tuna, horse-mackerel and 'Australian salmon'.

A further report gives information on the occurrence of pilchards, which provide live bait for tuna fishing. Analyses have been made of the age and growth-rate of the pilchard from the time of its hatching at sea, through the inshore phase which occurs early in the first year of its life, to its eventual return to the sea and attainment of maturity at the age of two to three years. (C.S.I.R.O. Bulletin 242, C.S.I.R.O. Bulletin 251.)

Teeth of Sheep

Abnormalities resulting from calcium deficiency in the development of teeth of young sheep, are closely similar to those from chronic fluorosis. Chemical analysis may be necessary to secure a differential diagnosis. Weaner sheep fed for several months on cereal diets which have relatively low calcium and high phosphorus content fail to develop normal teeth, even though their diet may be satisfactorily balanced in later life.

Research by the McMaster Laboratory of the C.S.I.R.O. shows that normal development may be secured by the addition of a calcium supplement to the diet, such as finely-ground limestone. Animals fed an abundant supply of calcium-deficient food showed less deterioration than those on marginal quantities of such food. Faulty pre-natal diet was found to have little effect on tooth development. (C.S.I.R.O. Bulletin 252.)

Commonwealth Assistance to Universities

The Commonwealth committee which was appointed by the Prime Minister to enquire into the financial needs of the universities has completed the interim report on the immediate financial needs. The report has been submitted to the Prime Minister, but has not yet been released to the universities. The committee is continuing with the long-term enquiry, following which it will report on the financial and other requirements of the universities and will make recommendations regarding Commonwealth financial assistance.

N.S.W. University of Technology

Professor R. M. Hartwell, of the Chair of Humanities, is visiting Switzerland and America to study methods of instruction. Professor D. W. Phillips has been appointed chairman of a committee to report to the N.S.W. Government upon methods of working and developing coal seams and conservation of coal resources in the Cessnock-Maitland coalfield. Mr. G. L. Macauley has been appointed as Registrar, thereby releasing Mr. J. C. Webb to his academic duties.

A degree course in Applied Physics and a degree course in Wool Technology will be established in 1951.

New England University College

Internal administration has this year been handed over by the University of Sydney to a local Advisory Council. The Senate of the University still makes staff appointments and is still responsible for the budget of the College.

Staff of the College are engaged on a programme of research into the historical development of northern New South Wales, together with its existing social and economic structure and existing problems. Material collected is being issued in the form of monographs. The third of these, entitled *Gold Mining around Walcha*, has recently been published.

University of Tasmania

A Students' hostel, to be known as the Jane Franklin Hall for University Women, has been opened in Hobart. Films of the University have been taken by staff of the Department of the Interior, for incorporation in a documentary film on Australian universities.

University of Sydney

To mark the centenary of the passage through the New South Wales legislature of the Act incorporating the University, an imposing ceremony was held at the University on 6 October 1950. The Great Hall was filled by 700 official representatives, and addresses were broadcast to 4000 others in the quadrangle and on the lawns. Visitors included the Governor of New South Wales, the Prime Minister of Australia, the Premier of New South Wales, representatives of the Churches, the Lord Mayor of Sydney, the Minister for Education, representatives of the Armed Services, and representatives of universities.

On 10 October 1950 the Senate of the University of Sydney attended Parliament House at the invitation of the President and Speaker to hear the debates upon a resolution of congratulation adopted to mark the Centenary of the University.

Recent appointments include W. H. H. Gibson as Acting Professor of Mechanical Engineering during the absence of Professor MacDonald; N. C. W. Beadle as senior lecturer in Botany; F. V. Mercer as senior lecturer in Botany; A. J. Baker as lecturer in Philosophy. C. A. Gibb has resigned his position as senior lecturer in psychology and has accepted the position of Visiting Lecturer at Dartmouth College, Hanover, New Hampshire, U.S.A. K. Viner Smith has resigned his position as senior lecturer in Pathology to accept an appointment with the Royal North Shore Hospital. E. G. Hallsworth has resigned his position as senior lecturer in Agricultural Chemistry to become Professor of Agricultural Chemistry at Nottingham.

Professor J. M. Ward will spend sabbatical leave in the Institute of Commonwealth Studies, London. He intends to complete his research in connexion with the history of federation movements in Australia, and to extend and revise his book on *British Policy in the South Pacific.* R. G. Howarth will spend sabbatical leave at the Universities of London and Oxford, completing research on John Webster and James Shirley.

University of Melbourne

Dr. H. D. Brasch, senior lecturer in Machine Design, died from injuries sustained in an accident on 3 November. Miss Margaret Blackwood, formerly lecturer in Botany and Dean of Women at the Mildura Branch, has returned from Cambridge and will rejoin the staff of the Botany Department. Associate-Professor Sexton is leaving in mid-December for four months to attend international conferences of civil engineers in India, and to visit schools of engineering in India, Pakistan and Ceylon. Associate-Professor Hercus will be on sabbatical leave in 1951 to visit universities abroad.

The University's representative at the fifth centenary celebrations of the University of Glasgow, in June 1951, will be Professor Crawford. Associate-Professor H. K. Hunt will also attend the celebrations.

Personal

Dr. J. H. Martin has arrived in Melbourne to be senior physicist at the Peter MacCallum clinic of the Victorian Cancer Institute. He will supervise the installation of £50,000 worth of high-energy X-ray equipment. He is, however to return temporarily to England via the United States.

A. D. McQuillan, research officer of the C.S.I.R.O., has been awarded the Ph.D. degree for research on titanium and titanium alloys. Dr. McQuillan is a graduate of the University of Durham and has been working in the Department of Metallurgical Research in the University of Melbourne.

Professor Leonard Russell, retiring Professor of Philosophy in the University of Birmingham, is to visit Australia under the auspices of the British Council in June and July next year. He is a trained mathematician and physicist as well as being an eminent philosopher. Professor W. Gentner, a distinguished German nuclear physicist, who is Director of the Physics Institute at Freiburg, will visit Australia for six months in 1951 as a guest of the Commonwealth Government. His particular field is in the problems of radiation in biology.

E. S. Barnes, the J. B. Watt Travelling Scholar of the University of Sydney, has been elected a Fellow of Trinity College, Cambridge. Mr. Barnes went to Cambridge in 1947 after lecturing in the Department of Mathematics in Sydney, and was a Wrangler in Part II of the Mathematical Tripos in 1948, with a mark of Distinction in Part III in 1949.

National University

Mr. L. N. Short, who has been appointed a Research Fellow in Medical Chemistry in the National University, is an M.Sc. of the University of Sydney and a former National University Scholar. He has been working under Professor Hinshelwood at Oxford, on the infrared spectroscopy of polyatomic molecules of biological interest.

International Conferences

1951

- January 3-10 — Hydraulic Structures Research, New Delhi.
- January 8-13 — Colloquium on Calculating Machines and Human Thought, Paris.
- January 10-15—World Power Conference, Sectional Meetings, New Delhi.
- January 10-15—IV Congress on Large Dams, New Delhi.
- March—General Assembly, I.U. Theoretical and Applied Mechanics, Rome.
- April 1-12—CXIX Meeting, American Chemical Society, Boston and Cleveland.
- May—III Congress of Hydatidosis, Brazil.
- May 28-30—Conference on Electrical Instrument Designs, London.
- May 28-June 6—III World Petroleum Congress, The Hague.
- June 4-15—Joint Engineering Conference, Institutions of Civil, Mechanical and Electrical Engineers, London.
- June 27-July 3—II General Assembly, I.U. Crystallography, Stockholm.
- July—IV Congress of the Sea, Ostend.
- July—Mathematical Colloquium, St. Andrews, Scotland.
- July 16-21—XIII Congress of Psychology, Stockholm.
- July 16-21—Conference on Automatic Control, Cranfield, England.
- August 1-8—General Assembly, Int. Astronomical Union, Leningrad.
- August 17-24—IX Congress of Entomology, Amsterdam.
- August 24-September 1—General Assembly, I.U. Geodesy and Geophysics, Brussels.
- August 29-September 11—Conference on Refrigeration, London.
- September 8-17—XII Congress and XVI Conference, I.U. Chemistry, Washington and New York.
- September 10-13 — II Congress, I.U. Leather Chemists' Societies, London.
- September 11-13—Discussion on Heat Transmission, London.
- September 11-20—Building Research Congress, London.
- December—II Congress on Industrial Medicine, Rio de Janiero.
- December 14-22—IV Congress on Mental Health, Mexico City.

1952

- April 29—VI Hydrographic Conference, Monaco.
- August 15-September 15—Congress for Applied Mechanics, Istanbul.
- August 8-13—Geographical Congress, New York.
- Undecided—XII Limnological Congress (Great Britain); XIX Geological Congress (New York); Society of Photogrammetry (Washington); II Congress of Biochemistry (Paris), VI Assembly I.C.S.U. (Holland).

The Societies

Royal Society of New South Wales

November: H. Wood, Tables for nearly parabolic elliptic motion.
H. Wood, Tables for hyperbolic motion.
T. G. Vallance, An occurrence for Boudinage structure in N.S.W.
Liversidge Lecture: H. R. Marston, F.R.S., Energy transactions in higher animals.

Royal Society of Queensland

October: Professor Wilson (Toronto), Lecture on geophysics.

November: M. Shaw, Graticules or reticles for optical instruments, and their manufacture.

Royal Society of Western Australia

November: G. E. Brockway, Eucalypts of the inland forests.

Royal Society of Tasmania

November: T. Hytten, The dollar problem.

Royal Society of Victoria

November: S. R. Mitchell (lecture), Stone tools of the Australian aborigine.

Institute of Physics, Australian Branch, N.S.W. Division

November: P. G. Law, The Norwegian-British-Swedish Antarctic expedition, 1950.

Medical Sciences Club of South Australia

November: Dr. Horowitz, Alkaloid production in plants and its significance to pharmacology and agriculture.

Ian Hiscock, Osmoregulation in freshwater mussels.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents. No notice is taken of anonymous communications.

Original Work

Viruses Isolated from Cases of 'Non-Paralytic Poliomyelitis' and Pathogenic for Suckling Mice

In an effort to gain more information on the etiology of 'non-paralytic poliomyelitis', attempts have been made to isolate viruses of the Coxsackie group (Dalldorf and Sickles, 1948; Dalldorf *et alii*, 1949; Melnick *et alii*, 1949, 1950), not yet reported in Australia, from the throat washings and faeces of such cases. This communication reports briefly the preliminary investigations made on viral agents (designated P29, W32 and J33) isolated in New South Wales.

Virus P29 was isolated from throat washings collected from a patient six days after onset of symptoms, virus W32 was isolated from faeces collected from a patient seven days after onset, and virus J33 from faeces from a patient three days after onset.

The routine technique adopted for the concentration of these viruses was as follows.

Throat washings.—These were collected in neopeptone heart broth (100 ml) which was then centrifuged for thirty minutes at 5000 r.p.m. in an angle-head refrigerated centrifuge at 4°C. To the supernatant fluid, penicillin and streptomycin were added to give final concentrations of 100 units/ml and 10 mgm/ml respectively. 24 ml were then centrifuged for one hour at 40,000 r.p.m. (144,000 *g*) in a Spinco ultracentrifuge. The deposit was taken up in approximately 2 ml of the supernatant fluid and frozen until it could be inoculated into suckling mice (24 hours old).

Faeces.—Faeces were prepared by making an emulsion in broth and centrifuging for 30 minutes at 5,000 r.p.m. at 4°C. The supernatant fluid was then centrifuged at 15,000 r.p.m. for 15 to 20 minutes at 4°C. Penicillin and streptomycin were added to the supernatant to give final concentrations of 100 units/ml and 0·5 mgm/ml respectively. Virus material was then concentrated in the ultracentrifuge in the same manner as for throat washings.

Observations of four passages of P29 virus in suckling mice reveal an incubation period following intraperitoneal inoculation of four to six days. The outstanding feature of the P29 and J33 strains is retardation of growth prior to the development of other symptoms. The animals became emaciated, moribund and showed tremors or paralysis of the extremities prior to death. Retardation of growth was not obvious with the W32 strain.

The histopathology of suckling mice dying as a result of intraperitoneal inoculation of P29 virus reveals no myositis, which is such a constant feature of infection with the Coxsackie group of viruses but not evident as a result of infection with the 'Powers' virus (Cheever *et alii*, 1950; Pappenheimer *et alii*, 1950). Destruction of the pancreatic acini, which is also characteristic of the 'Powers' virus, has not yet been observed in the case of P29 virus.

A more detailed account of these observations will be reported in subsequent publications, together with a comparison of the Australian strains with those isolated in the U.S.A.

N. F. Stanley,
Lila Hayes.

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Sydney.

10 November 1950.

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Nucleoproteins in Virus Infection

Bauer (1949) has suggested that virus multiplication takes place in close relationship to cytoplasmic particles. We have been investigating the relation of the virus to the cell by measuring the relative specific activity of nucleoprotein phosphorus of various cellular components in normal and infected liver.

By using a large infecting dose of ectromelia virus, it is possible to obtain mouse liver in which most of the cells are infected. Four hours after injection of P^{32} the livers were removed and fractionated by differential centrifugation (Claude, 1946). In infected liver there was an increased activity in the mitochondria and microsomes, but the activity of smaller particles, the supernatant from centrifugation at 18,000*g* for thirty minutes, had a lower activity than corresponding fractions from normal livers. The activity of total nucleoprotein phosphorus of isolated nuclei was the same in normal and infected livers.

The virus appears to act directly on the cytoplasm and not by way of the nucleus, and does not have a uniform effect on all cytoplasmic particles. The increased activity persists or increases right up to the time of death of the animal from the infection. This is unexpected, as many other metabolic processes, e.g., oxygen consumption, lactic acid production, acid phosphatase activity, tend to diminish in the terminal stages of this infection. This fall in metabolic activity is associated with the finding that some 10 per cent. of the cells show histological necrosis. Thus the increase in nucleoprotein activity may be even greater than the results suggest.

Further work is necessary to decide whether the mitochondria or microsomes have the greater increase in activity.

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A. R. Hoyle,
D. J. Metcalf.

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14 November 1950.

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Purification of the Receptor-Destroying Enzyme of V. cholerae

Burnet, McCrea and Stone (1946) first described the receptor-destroying enzyme (RDE) produced by *V. cholerae*. Some degree of purification of the enzyme was achieved by adsorption on to and elution from erythrocytes (Burnet and Stone, 1947). This procedure forms the basis of the technique outlined below.

Growth of the organism.—The strain 4Z of *V. cholerae* is maintained as a stock culture by weekly subculturing on nutrient agar. For growth of the organism, four 50-ml flasks of Wright's heart infusion broth are inoculated with a loopful of the stock culture and incubated in a water-bath at 37°C for six to eight hours, when a fair degree of turbidity is produced. Two ml of this material is used to inoculate each of a number of stainless steel trays (20·5 cm × 25·5 cm × 3·5 cm) containing 200 ml of Wright's heart infusion agar (0·8% agar). The inoculated trays are incubated at 37°C for seventeen hours.

Destruction of the organisms and removal of agar.—Immediately after pooling the cultures, calcium chloride is added to give a final concentration of 0·5%. The *p*H is adjusted to approximately 6·0, the mixture brought to 54°C to 56°C with stirring and held there for thirty minutes. After first cooling to about 4°C, the contents are frozen and on thawing the agar shrinks to such an extent that upon centrifugation or filtration a clear extract is obtained in good yield.

Methanol Precipitation of RDE.—Unless otherwise stated, all procedures described in the following sections are carried out at 0°C.

The *p*H of the extract is adjusted to 5·0 with $_N$HCl. Methanol, previously cooled to −40°C, is added with constant stirring to give a final concentration of 60% (V/V). After forty-eight hours, the precipitate is collected by centrifugation and resuspended in a minimum amount of 1% NaCl (W/V). The suspension is then dialysed for twenty-four hours against 20 volumes of 1% NaCl containing 0·1% (W/V) $CaCl_2$. A clear supernatant is obtained on centrifugation and the residue submitted to the same extraction procedure. The supernatants are pooled.

Adsorption on to and elution from red cells.—This step follows closely the procedure adopted by Burnet and Stone (1947) with the modifications (a) that the ratio, extract/red-cells, is changed to 2, and (b) that the *p*H of the extract is adjusted to 9·2 with borate buffer.

Ammonium sulphate fractionation.—The enzyme is precipitated by 60% saturation of the eluate with ammonium sulphate. After three days the precipitate is suspended in the smallest convenient volume of 0·05% (W/V) $CaCl_2$. This suspension is dialysed for forty-eight hours against two changes of the diluent and finally centrifuged at 18,000 *g* for one hour. The supernatant contains about 500,000 units/mgm dry weight, representing a 500-fold purification of the crude extract.

G. L. Ada,
E. L. French.

Walter and Eliza Hall Institute
of Medical Research,
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7 November 1950.

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Note on the Occurrence of a Shelly Facies in the Ordovician at Cliefden Caves, near Mandurama, N.S.W.

In April 1949 the writer, accompanied by G. Packham, found Ordovician graptolites associated with trilobites and small brachiopods in black cherts and impure limestones near the head of Copper Mine Creek, 12 miles west of Mandurama and 10 miles north of Woodstock, N.S.W. This led to the investigation of the nearby Walli-Cliefden Caves limestone belt, which had been reported upon and partly mapped by Carne and Jones (1919). These and other previous workers took the age of the limestones to be Silurian.

The area has now been geologically mapped, showing the main structure to be an anticline, plunging north. Andesites, basalts, tuffs, cherts and breccias occur in the core of the fold, under the main limestone belt, which may be called the Cliefden Caves Limestone. Some slates, cherts and impure limestone or marls are interbedded with the Cliefden Caves Limestone, and similar rocks overlie it (as at Copper Mine Creek). Ordovician graptolites have been found in rocks apparently underlying, interbedded with, and overlying the Cliefden Caves Limestone. The graptolites, which are in strata interbedded with the limestone, belong to the zone of *Glyptograptus teretiusculus*, and are certainly older than Eastonian. Even some of the limestones contain graptolites; these are very well preserved. At many places the graptolites are associated with trilobites, brachiopods and gastropods. The Cliefden Caves Limestone itself is highly fossiliferous, especially towards the base, containing abundant Strophomenid brachiopods in an excellent state of preservation, together with Trinucleid trilobites and primitive tabulate corals.

This is the first record of fossiliferous Ordovician limestone in N.S.W., and it is interesting for purposes of correlation to find shelly and graptolitic facies occurring together. Hall (1900) described Ordovician graptolites associated with an Agnostid trilobite and (?) *Obolella* from Mandurama, but the locality is presumed to be Junction Reefs, some miles upstream from Cliefden Caves. The writer also found a Diplograptid graptolite recently near this locality.

The discoveries in the Cliefden Caves area have interesting consequences, for if the Cliefden Caves Limestone is Ordovician, the underlying volcanic rocks are Ordovician, confirming the ideas of Pittman (1900) and others that at least some of the andesitic lavas in this region are Ordovician in age.

The writer wishes to thank Dr. I. A. Browne and Dr. W. R. Browne, Dr. Öpik and Mrs. Sherrard for their interest and help in this work.

N. C. STEVENS.

Department of Geology,
University of Sydney.
14 November 1950.

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Pyridine-Amyl Alcohol as a Paper Chromatography Solvent for Amino Acids

Phenol and collidine have remained the most universally used pair of solvents for two-dimensional paper chromatography of amino acids since their introduction by Consden, Gordon and Martin (1944). The use of the latter solvent, however, is attended by certain disadvantages such as double spots and haloes (Bentley and Whitehead, 1950), an offensive smell and possible toxic effects (Holtzmann, 1936; Ludwig, 1935) and in some countries difficulty of supply. Alternative solvents have been suggested—for example, pyridine-amyl alcohol (Edman, 1946), butanol-acetic acid (Phillips, 1949), acetone-water (Bentley and Whitehead, 1950) and mesityl-oxide-formic-acid (Bryant and Overell, 1950).

The equal-volume mixture of pyridine and amyl alcohol as suggested by Edman (1945) has been tried on synthetic amino acid mixtures and protein hydrolysates but with rather unsatisfactory results. Some typical R_f values in this solvent are given in Table 1, from which it can be seen that the distance of migration of the acid spot is too small to render this mobile phase generally useful. Increased R_f values were obtained with a mobile phase composed of two volumes of pyridine with one volume of amyl alcohol, the mixture being shaken with three volumes of water and the separated phases used in the usual manner. Whilst the amino acids moved considerably further in this solvent mixture, the R_f values obtained were found to be very similar to those obtained with tertiary amyl alcohol (Table 1).

TABLE I.
R_f Values of Amino Acids

	Pyridine-Amyl Alcohol (1/1)	*Pyridine-Amyl Alcohol* (2/1)	*Tertiary Amyl Alcohol*
Arginine* ...	0·01	0·02	0·02
Aspartic Acid	0·00	0·01	0·01
Glutamic Acid	0·00	0·01	0·01
Glycine	0·02	0·04	0·06
Histidine ...	0·01	0·07	0·06
Leucine	0·17	0·30	0·28
Phenyl-alanine ..	0·20	0·30	0·32

* As monohydrochloride.

The usual drying and heating temperatures required for ninhydrin-identified amino acids bring out an undesirable blue background with the pyridine-amyl-alcohol systems. To reduce this effect to a minimum the best procedure has been found to consist of air-drying the paper for several hours or preferably overnight and then, after spraying with ninhydrin, to develop the colours at as low a temperature as possible.

Both ascending and descending methods of solvent migration have been used with the pyridine-amyl-alcohol mixtures, with no difference in R_f values. The ninhydrin-sprayed spots have been found to be always of a purple colour, except for proline, which was its characteristic yellow. With most spots there was a tendency for tailing, the tails running away from the initial spot in the direction of solvent migration. The intensity of the tails appeared to increase with time after spraying.

The fact that the R_f values in pyridine-amyl alcohol mixtures are so low would appear to preclude its use as a universal second-dimensional amino acid solvent. Bentley and Whitehead (1950) have reported that pyridine containing 35% water gives R_f values for amino acids closely approximating those obtained with their preferred solvent — acetone containing 40% water. Investigations have been commenced on the use of the latter solvent and results to date appear to indicate that it may give satisfactory resolution of a large number of acids.

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30 October 1950.

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Paper Chromatography of N-Bases

In an earlier communication the chromatographic separation of pyridine, quinoline, *iso*-quinoline and collidine was described (Walker, 1950). Since then R_f values for acridine, α-, β- and γ-picolines, lepidine, 2-6 lutidine and quinaldine have been obtained. This letter describes the application of the method to the separation of nitrogen bases in 'crude pyridine oil' from B.H.P. Coal Tar Plant, Newcastle.

Previously from 'crude pyridine oil', Ochiai and Haginiwa (1940) extracted and purified pyridine, α-picoline, 2-4 and 2-6 lutidine and 2-4-6 collidine.

Crude pyridine oil (5 ml) was mixed with 5N HCl (5 ml) and a drop chromatographed with pyridine, α-picoline, 2-6 lutidine and 2-4-6 collidine. The solvent and procedure have been described (Walker, 1950).

As seen in Figure 1, the mixture gives four spots, the R_f values of which correspond to those of the pure reference compounds. It seems, therefore, that this specimen of crude pyridine oil contains pyridine, α-picoline, 2-6 lutidine and 2-4-6 collidine.

Crude pyridine oil	*Collidine*	*2-6 Lutidine*	*a Picoline*	*Pyridine*	*Crude pyridine oil*
·87	·87				·86
·71		·69			·69
·54			·51		·52
·34				·35	·34

R_f values (to second front)

Figure 1.

This result is to be checked by another method, and is now described as an application of paper chromatography to organic mixtures. Another coal tar fraction containing N-bases is being examined, as also various shale oils.

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8 November 1950.

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Reviews

Agriculture

THE ESTABLISHMENT OF VEGETATION ON INDUSTRIAL WASTE LAND. By R. O. Whyte and J. W. B. Sisam. (C.A.B. Joint Pub. No. 14, 1949. 78 pp., many photographs. Obtainable from C.A.B. Liaison Officer, 314 Albert Street, East Melbourne, C.2.) Price, 12*s*. 6*d*.

Reclamation of industrial waste land can be accomplished by the slow natural processes of ecological succession, commencing with pioneer plants of very low nutritional requirements. The process may be accelerated by first improving the soil environment and then establishing vegetation artificially.

Most of the information in the Publication has been collected from unpublished sources. In the Black Country of the United Kingdom,

mining and industrial waste material have created a wasteland of spoil banks from coal and ore mining, and of deposits of slag, ash and cinders, which, with quarrying, brickworks and so on, amounts to 12·8 per cent. of the region. Anthracite open-cuts in Pennsylvania, U.S.A., have devastated more than 100,000 acres which have already been partly reclaimed by planting *Robinia pseudoacacia* and pines.

The Publication, after introductory descriptive chapters, discusses factors affecting treatment. The object of reclamation is given as landscape improvement, stabilization, or the provision of economic returns from timber or grazing. The habitat offered to plant growth is unfavourable because of toxic conditions and deficiency of nutrients, so that a period of weathering (at least a year) is required before even the most hardy plants will grow.

Information is given on the establishment of vegetation by artificial means. Suitable species of trees and shrubs are indicated, with alternative establishment techniques; together with examples of the establishment of grazing or pasture mixtures and the techniques adopted. The final chapter deals with the surveying of derelict land with a view to reclamation, including physical characteristics (other than detailed soil analysis).

A bibliography of published and unpublished references is appended, with an index of species and list of common names. The Publication will appeal to the popular reader as well as to the technical reader.

D. A. N. CROMER.

Botany

AN INTRODUCTION TO PLANT SCIENCE. By W. W. Robbins and T. E. Weier. (New York: John Wiley; London: Chapman and Hall, 1950. 480 pp., numerous text-figs. 7¾″ × 9¼″.) Price, $5.00.

In the introduction to this book we are told that the world holds 11,422 professional botanists. Judging by the number of new American elementary textbooks, the majority of these people must be Americans. To a professional botanist, still another college elementary text can hardly be expected to provide stimulating reading, but Robbins's and Weier's textbook is a welcome change from some of its forerunners. Like so many American texts it is most beautifully produced, with two columns of print on each of its broad pages. A great many of the drawings are new and lively and they are well-spaced so that students never have to 'make the effort necessary to turn a page or two in order to find a figure referred to in the text'. Most of the photographs are a delight. As one would expect from senior members of the University of California, the standard is high—it covers very fully the first-year work at an Australian university and goes a good deal further in some sections. It is just this feature which sets the book apart from the usual run—in almost all chapters there is evidence of writing by research-minded people, and moreover by people keenly alive to the practical side of the subject. In the text proper this is not overdone and it is rather a pity that the introduction, discussing the work of a botanist, pays too much attention to the applied side.

The book opens very sensibly with a brief account of the plant world. Then follows a useful chapter on classification and naming. Here we have one of our few criticisms. It is all very well to be up to date in physiology and genetics, but it seems unnecessary to confuse the young student with recent suggestions concerning the naming and arrangement of the main plant phyla, especially when the reasons for changes are not discussed. The student is not likely to look with favour on the systematic botanist who provides him with the choice of the terms Chlorophycophyta and Chlorophyceae; Lycopodinae and Lycopsida.

Pages 45 to 256 are occupied by a full account of the structure, physiology and reproduction of the flowering plant, and one is impressed here with the general high standard of the presentation. The applied approach is also rather refreshing. Thus in the chapter on fruits we find good illustrations of the fruit of coconut and orange, and the section on pollination deals with fruitfulness and sterility in horticultural varieties of apples and pears, and with artificial pollination. Chapter 12, on the 'Plant as a Living Mechanism', contains an unusually good account of trace elements, with some splendid illustrations; besides the usual story of the auxins, there are six interesting pages dealing with the vitamins. A similar high standard is maintained in the chapters on bacteria and virus, which are notable for the electron-microscope photography. The latter part of the book deals with the lower plants and there is a short concluding chapter on evolution and its mechanism. Here (on page 460) the statement about linkage conflicts with the earlier account of crossing-over, but the main fault is the lack of stress on the importance of natural selection.

It is difficult to find fault with the physiology, but on the cytological side there is some room for improvement. The distinction between mitosis and meiosis is not as clear as it could be, and on page 240 (line 8) the description of prophase could be much improved. On page 75 'tractile fibres' are spoken of as attached to the kinotochore, a statement which is corrected over the page, just a little too late. Figures 5.17 page 75 and 11.10b page 242 are incorrectly labelled 'metaphase'. Most of the photographs of cell division, although striking, are of little real value. And incidentally, Australians would like to see *Tmesipteris* pictured as it grows, hanging downwards.

These are unimportant errors in an otherwise excellent book. The absence of ecology with its local examples is almost an advantage for those who will use the book outside America. Although it lacks the thought-provoking personal approach of Priestley and Scott's text, yet in standard, accuracy and originality this book compares favourably with most English and American texts. It is a book that I would confidently recommend to my own students and its only drawback to use in Australia is its price.

J. S. TURNER.

Chemistry

QUANTITATIVE ULTRAMICROANALYSIS. By P. L. Kirk. (New York: John Wiley, 1950. 310 pp., 110 text-figs. $5\frac{1}{2}'' \times 8\frac{1}{2}''$.) Price, $5.00.

The development of microchemical methods of analysis, involving precipitations, filtrations and titrations on samples no greater than a few milligrams at most, extended the useful applications of analytical chemistry, particularly in the biological field. Such refinements have now been carried one-thousandfold further. In the book under review, Professor Kirk ably outlines these new techniques. Not so many years ago chemists, untrained in microchemical methods, were somewhat sceptical of separations involving microgram quantities. Today, with a knowledge of the extremely small amounts of some elements required for the normal growth of plants and animals and the even smaller amounts involved in the nuclear chemical transformations, the microgram becomes an unduly large unit.

Ultramicroanalysis is defined as the determination of constituents in a sample of the order of micrograms. Professor Kirk stresses the value and importance of these techniques either when the samples available are very small (e.g., cellular chemistry, insect physiology) or in those cases where the use of larger samples would expose the operator to unnecessary hazards (as in analyses involving strongly radioactive isotopes). In the latter field, the new techniques enabled Professor Kirk and his students to work out the fundamental chemistry of plutonium before as much as one milligram of this element was in existence.

Several chapters are devoted to a detailed description of microgram-titration equipment, quartz-fibre balances (with a sensitivity of 0·005 microgram yet capable of weighing loads of several decigrams), spectrophotometric equipment, and other apparatus for the filtration, centrifuging and distillation of samples on a correspondingly small scale. Specially devised micro-separating funnels are particularly neat and ingenious. By their use separations from the aqueous phase may be made with as little as one drop of a light or heavy solvent. When sensitive organic reagents are being used for metals there is no need to stress the increased sensitivity given by such refinements.

Acid-base and oxidimetric titration techniques are followed by specific methods for the determination of individual elements in different materials. The titrimetric methods described for sodium, potassium, calcium and iron are said to be capable of determining quantities somewhat less than one microgram with an accuracy which is in general better than 1 per cent. The precautions and strict attention to detail necessary for accurate work are illustrated in the method described for sodium. To avoid errors, care must be taken to prevent contamination with minute amounts of sodium derived from the finger tips or dissolved from the glass apparatus. The author contends, however, that the teaching of the new ultra-micro techniques presents no greater difficulties than that of ordinary micro-methods.

Not content with ultra-micro methods, Dr. Kirk devotes a chapter to submicrogram methods, in which the inherent sensitivity of spectrophotometry is enhanced by making all separations on a micro scale and developing the final coloured compound in an extremely small volume. The only modification of the ordinary spectrophotometer has been the design of suitable absorption vessels, which will give a long light path yet hold only 0·05-0·20 ml of solution.

A final chapter deals with other physical methods, such as melting point, boiling point and conductivity, all carried out on the micro scale. Such specialized instruments as the polarograph and the spectrograph are not described in detail because they are best used by specialists. It is pointed out, however, that ultramicro techniques in preliminary separations will enhance the sensitivity obtainable by these instruments.

The book brings together many useful techniques and methods and each chapter is concluded with a well-selected bibliography. The large number of references to the published work of Kirk and his students bears testimony to the important part played by him in developing or improving suitable methods. The volume is clearly printed and freely illustrated. Typographical errors are few: 'effluoresce' for 'efflorescce' escaped correction three times in Table 3, while the unfortunate transposition of 'macro' and 'micro' in Table 1 is somewhat confusing. This is a book which it is safe to predict will become widely known and used in many fields of analytical chemistry.

C. S. PIPER.

Coal

COAL, COKE AND COAL CHEMICALS. By P. J. Wilson and J. H. Wells. (New York: McGraw-Hill, Chemical Engineering Series, 1950. 509 pp., numerous text-figs., 97 tables. $6\frac{1}{4}'' \times 9\frac{1}{4}''$.) Price, $8.00.

This book gives a brief but valuable introduction to the study of fuels and combustion in general, as well as the origin, classification and properties of coals. Its main purpose, however, is a treatment of all aspects of modern coal-carbonization industries, including high-temperature coking, low-temperature carbonization and the by-product industries. The authors have given a well-balanced treatment with respect to design and operation of American plants, as well as the more technical aspects of processes involved and factors influencing the nature of products. In addition, consideration is given to the economics of the carbonization industries in America.

Photographs and diagrams have been used liberally to illustrate all sections of the book, and the text is written in such a way that highly technical and specialized discussions can be followed readily by readers other than those well versed in the subjects.

In view of the nature of the book and the limited number of references available on contemporary practice in coal carbonization, this work should be a valuable text for fuel technologists, chemical engineers, industrial chemists and economists, not only in industrial fields but also in teaching and research. It is, however, essentially a treatment of coal carbonization in America and is obviously written for American readers. This is perhaps a little unfortunate, as the authors intended it to be a comprehensive work on modern industrial practice and economy in the field of coal carbonization. Some information about the British and European industries could well have been included to broaden the scope and to enhance the value and interest of the book, possibly even to some American readers.

J. A. DULHUNTY.

Electronics

ELECTRONICS IN ENGINEERING. By W. Ryland Hill. (New York: McGraw-Hill, Electrical and Electronic Engineering Series, 1949. 274 pp., numerous text-figs. 9¼″ × 6″.) Price, $3.50.

In the preface this book is described as one for 'the advanced engineering or science student who wishes to learn something of electronics and its applications to his problems'. Each section is introduced in quite elementary but nevertheless sound fundamental terms, and simple practical applications follow. Throughout there is a very close association of practice with principle. The non-specialist will not find himself bogged down in detailed theory or, for that matter, in detailed practical data—it is in no sense a designer's handbook.

There are sixteen chapters: five on atomic structure, thermionic emission and the application of these principles in the better-known valves and electron tubes. There is a chapter on photosensitive devices, nine chapters dealing with the applications of electron tubes in rectifier circuits, amplifiers, oscillators, modulators and the like; and in addition there is one chapter on the cathode ray oscilloscope and one on transducers. The book is well illustrated with graphs and diagrams.

W. K. CLOTHIER.

ELECTRON-TUBE CIRCUITS. By Samuel Seely. (New York: McGraw-Hill, Electrical and Electronic Engineering Series, 1950. 529 pp., numerous text-figs. and plates. 9¼″ × 6″.) Price, $6.00.

This book has been prepared for the student and seeks '(a) to develop in the student a clear, analytical method in the study of electron-tube circuits; (b) to present and study the various classes of circuits which find widespread application; (c) to indicate, with examples, how one proceeds to combine circuits of various types to achieve either one or a multiplicity of operations'. A wide range of material is included and with the above objects in view the author has quite rightly avoided confusing the student with too much discussion of the finer points of any one field. It is thought, however, that some mention could have been made in the chapters on amplifiers of the limitations imposed by noise. The material is very clearly presented and the diagrams and circuits are well drawn and easy to follow. One confusion was noticed on page 89 where, after analysing the effects of current and voltage feedback, it is stated that the 'effect of negative feedback of all types is to decrease the output impedance of the amplifier'. This obviously only applies to voltage feedback.

There is a chapter on electronic computing circuits and a considerable amount of material derived from radar applications. This book would serve as a very useful introduction to either of these fields. To assist the student, each chapter ends with a number of references and problems.

A. M. THOMPSON.

Forestry

APPLIED SILVICULTURE IN THE UNITED STATES. Second edition. By R. H. Westveld. (New York: John Wiley; London: Chapman and Hall, 1949. 590 pp., 102 text-figs., 38 tables. 9″ × 5¾″.) Price, $6.00.

As indicated by the author, this treatise 'deals with the ecological background and economic problems of the forest types in the U.S.A. and the application of various silvicultural measures to meet varying situations'. In this new edition, Westveld has adopted the same general arrangement of his material as in the original work published in 1939, but he incorporates the results of further intensive research and observation and modifications in

silvicultural technique which have taken place during the intervening decade. In his preface, he indicates that the substantial economic changes which have developed during this period, both as regards marketing conditions and operational costs, have tended towards modification of practical silvicultural methods.

The material presented has reference specifically to forests and forestry practice in the U.S.A. For purposes of discussion, the author divides the country into eighteen regions, within each of which he considers the forest problems are broadly of uniform character; and each region is further subdivided into its major component forest types. A chapter is devoted to each region, which is described briefly in terms of its location and extent; physiography and climate; past cutting practice and its effect on the composition and condition of present-day stands. For each forest type within each region, its ecology and silvicultural characteristics, economics of utilization, financial considerations in relation to silvicultural costs, and complications introduced by disease and insect attack, are discussed. Finally, the author sums up by recommending for each forest type a practical form of management based on the extent of present knowledge of the foregoing factors and an analysis of the results of past methods. This summing up is concise, interesting and instructive.

One factor to which the author directs attention is his recognition of the weakness, when analysing comparative costs and returns, which is associated with changes taking place from time to time in monetary values; and he has endeavoured to overcome this by expressing certain costs in terms of man-hours. Whilst this expedient may be useful in comparing operational costs, it does not make provision for offsetting costs against financial returns which cannot be expressed in this standard.

The general standard of production is high; a comprehensive selected list of references relating to each region and an adequate selection of clear illustrations being features worthy of special mention. The names adopted for species conform to the *Check List of the Native and Naturalied Trees of the U.S., Including Alaska, 1944*, prepared by the U.S. Forest Service. The publication is recommended for careful study by all who are interested in problems of silviculture and, particularly, in the development of applied silviculture in relation to economics.

K. V. M. Ferguson.

Geology

Applied Sedimentation—A Symposium. Edited by Parker D. Trask. (New York: John Wiley, 1950. 707 pp., numerous text-figs. and tables. 6″ × 9¼″.) Price, $5.00.

Those familiar with earlier symposia edited by Parker D. Trask (*Origin and Environment of Source Sediments of Petroleum*, 1932; *Recent Marine Sediments*, 1939) will welcome the appearance of this new book, which, as stated in the Preface, is designed (1) to describe aspects of mutual interest to the geologist and to the engineer so that each can understand the other's problems and thus co-operate more effectively in their work; (2) to provide information for the consulting geologist who may not be completely familiar with specific problems; and (3) to acquaint students with the many practical applications of sedimentation so that they may be more fully informed as to the possibilities of a career in this field.

The symposium is divided into seven parts: (1) Basic Principles of Sedimentation; (2) Engineering Problems involving Strength of Sediments; (3) Applications of Processes of Sedimentation; (4) Applications involving the Nature of Constituents; (5) Economic Mineral Deposits; (6) Petroleum Geology Problems; (7) Military Applications. Within each part there are several chapters, amounting to a total of thirty-five in the book, each written by an expert in that particular field. In a short review it is not possible to comment on every aspect of sedimentation discussed and the following remarks are confined to the more interesting aspects of the subject.

Part I starts with an introductory chapter by P. D. Trask which summarizes the principal features of sediments, emphasizing the processes that lead to their formation or that cause them to change once they have been formed. This is followed by a useful chapter on 'The Origin of Soils' by Hans Jenny. The next chapter should logically be 'Principles of Soil Mechanics as viewed by a Geologist' (Clifford A. Kaye), but this appears at the end of the part. Chapter 4, 'Geophysical Problems in Applied Sedimentation', by Roland F. Beers, seems rather an unnecessary inclusion here. Part II has chapters on sediments and highway engineering, foundation problems of bridges and dams, etc., and concludes with 'Sedimentary Geology of the Alluvial Valley of the Lower Mississippi and its Influence on Foundation Problems'. This chapter is probably of greater use and interest to geologists in the United States than elsewhere, although it clearly explains the importance of the advance and retreat of continental glaciers on the behaviour of the Mississippi during its development. In Part III, the chapter on 'Permafrost' (permanently frozen ground), by Robert F. Black, gives the results of study in Alaska during military operations, and indicates the effect of permafrost on engineering, geologic, biologic, and other problems for which few facts were hitherto available. Some references to Russian work are included. Chapters on 'Shore-control Problems' and 'Sedimentation in Harbors' are

well worth reading, the former for its insistence on the definition of physiographic units for shore investigation problems. Other chapters deal with soil conservation and gullying and summarize the knowledge adequately. Part IV has chapters on concrete aggregates, a good summary of the composition and physical properties of clays by R. E. Grim and of foundry sands by H. Ries. Economic mineral deposits (Part V) in sedimentary rocks summarizes this aspect of economic geology, but could quite well have been omitted, as this field is adequately covered by readily available books. The same might be said of Part VI, petroleum geology problems, where many detailed techniques of well-drilling, etc., are included; though the porosity of sediments is discussed and its importance stressed. The last Part (VII) is interesting: Chapter 34 outlines the use of the field geologist in military operations, and Chapter 35 that of the geologist in naval affairs. One direct result of naval research is the detailed account which has been made of Bikini Atoll. It is noteworthy that reference is made almost entirely to the Pacific, whereas probably the most successful application of sedimentation during military and naval operations was the examination of the material on the Normandy beaches, which gave necessary information to the Allies to ensure a successful landing. There is some repetition of subject-matter, e.g., landslides are described in chapters 5 and 13, sedimentation in reservoirs in chapters 20 and 22; but this is perhaps excusable, as certain subjects overlap and each chapter is intended to be complete in itself.

The study of sedimentary processes and the resulting sediments is in its infancy in Australia and for that reason alone this authoritative book is useful to Australian readers; it should be available for all students in geology and civil engineering to consult, even though it is a typical American book, written for Americans by Americans, and with examples and illustrations drawn almost exclusively from the United States.

This book is well printed and bound. It was prepared under the direction of the Committee on Symposium on Sedimentation, Division of Geology and Geography, National Research Council, Washington, D.C.

DOROTHY CARROLL.

Nuclear Science

COUNTING TUBES—THEORY AND APPLICATIONS. By S. C. Curran and J. D. Craggs. (London: Butterworth, 1949. 238 pp., 119 text-figs., 23 tables. 6″ × 9¾″.) Price, £2. 7*s*.

This book will be welcomed by all experimentalists who find that the use of counters for the detection of radiations from radioactive materials will assist them in their research. It has been written especially for workers in chemistry, metallurgy and medicine, and other graduates who are concerned with applied nuclear physics. Its usefulness will be extended by the fact that, although the theory and applications of Geiger counters are emphasized, ionization chambers, proportional counters and scintillation counters are discussed in some detail.

The first six chapters contain an excellent account of the theory and operation of ionization chambers, proportional counters and Geiger counters. Many tables and curves, helpful to counter design, are included but are distributed throughout the text. A more desirable arrangement may have been to collect the most important ones together in a brief appendix where they would be immediately available for reference. Other types of counters, particularly the scintillation counter, are discussed briefly in Chapter 10.

Chapter 8 deals adequately with the more common electronic circuits associated with counters. While some are previously unpublished, others developed by T.R.E. and A.E.R.E. are now commercially available.

Bearing in mind the main object of the authors—applied nuclear physics—it is understandable that little is said concerning the detection of neutrons and fission fragments, since this comes more properly within the realm of pure nuclear physics. The general impression of overcrowding may have been relieved by the omission of Chapters 9 and 11 on applications to nuclear physics and cosmic rays. These sections are of necessity sketchy and are already, as the authors themselves point out, somewhat obsolete. Chapter 7 on counter construction and Chapter 12 on general applications might, instead, have been expanded and amplified.

An extensive bibliography at the end of each chapter enhances the value of the book, particularly to the newcomer to counter techniques. In spite of its relatively high price, the book (which has been well set up and printed and is of pleasing appearance) should find a place in any laboratory which makes or uses electrical particle counters.

D. N. F. DUNBAR.

TRILINEAR CHART OF NUCLEAR SPECIES. By W. H. Sullivan. Art work by Kay Benscoter. (New York: John Wiley; London: Chapman and Hall, 1949. 11″ × 9¼″, card covers.) Price, $2.50.

The *Trilinear Chart of Nuclear Species* is described as presenting, on a single continuous strip ten inches wide and about twelve feet long, the systematics and physical data for all experimentally identified nuclear species known from information available at June 1949. The chart does indeed convey a great wealth of information. By appropriate colouring and

lettering one can see at a glance nuclides that occur in nature, that are produced artificially, and whether they show β or α instability. The whole chart has been exceptionally well done, except for one thing: some of the lettering is too small and too difficult to read. This arises largely because of the attempt to make the chart too nearly encyclopædic in regard to physical data. Because of its size and shape there may be some difficulty in making it a permanent exhibit in a hallway or lecture theatre. It should, however, be most useful for reference and, in a general way, for teaching purposes.

D. P. MELLOR.

Organic Chemistry

ORGANIC REACTIONS. Volume V. Edited by Roger Adams. (New York: John Wiley; London: Chapman and Hall, 1949. 446 + viii pp., many text-figs. and tables. $5\frac{3}{4}'' \times 9''$.) Price, $6.00.

The appearance of this fifth volume in the series of descriptions of organic synthetic reactions will be welcomed by all organic chemists, who have come to regard the series as among the most useful and important compilations on their library shelves, and invaluable for synthetic work. Ten reactions are discussed in the present volume and the selection includes some very important reactions. Thus, T. L. Jacobs of the University of California, Los Angeles, discusses the methods of synthesis of acetylenes, citing over 500 literature references. In view of the greatly reawakened interest in acetylene chemistry, largely because of the wartime achievements of Reppe, the present account is most timely. L. W. Butz and A. W. Rytina add a further chapter to the two already published in Volume IV dealing with the Diels-Alder reaction, the present one being confined to quinones and other cyclenones. H. A. Bruson, of the Rohm and Haas Company, Inc., abundantly qualified by the wide experience of his personal researches, discusses the fifteen-years-old but nevertheless extensive cyanoethylation reaction. The Schiemann reaction—the preparation of aromatic fluorine compounds from diazonium fluoborates—is discussed by Arthur Roe of the University of North Carolina. A sixty-page chapter citing almost 300 literature references and dealing with the employment of dibasic acid anhydrides in the Friedel-Craft reaction is contributed by Ernst Berliner. By contrast, it requires N. N. Crounse only ten pages to dispose of the very much more restricted Gattermann-Koch reaction.

In the final hundred pages of the book four other very important reactions are discussed: the Leuckart reaction by M. L. Moore; selenium dioxide oxidation by N. Rabjohn; the Hoesch synthesis by P. E. Spoerri and A. S. DuBois; and the Darzens glycidic ester condensation by Melvin S. Newman and B. J. Magerlein. The book is excellently printed and produced.

F. LIONS.

Optics

INTRODUCTION TO THEORETICAL AND EXPERIMENTAL OPTICS. By Joseph Valasek. (New York: John Wiley; London: Chapman and Hall, 1949. 454 pp., 44 text-figs., 6 tables $8\frac{1}{2}'' \times 5\frac{1}{2}''$.) Price, $6.50.

This book covers a very wide field in a form which, though concise, omits none of the essentials required for a basic knowledge of optics. The exposition is clear, and appropriate references are made to recent work. But for its price, with the present Australian equivalent for the dollar, it might well be prescribed for individual purchase as the text-book in optics for all students taking physics as major subject for a B.Sc. degree. More detailed accounts of specialized fields could be covered by access to libraries. The subjects of X-rays, photographic optics, and ophthalmic lenses are dealt with in greater detail than is usual in optical text-books.

The book is divided into four main sections:

I. *Geometrical Optics* (105 pages) includes a treatment of Fermat's principle, two pages on trigonometric ray tracing, the Gaussian treatment of centred systems, a descriptive account of the Seidel aberrations, and chapters on photometry and stereoscopy.

II. *Physical Optics* (153 pages) covers diffraction, interference, Michelson and Fabry Perot interferometers, double refraction and the optical properties of metals. Maxwell theory is applied to establish the Fresnel formulae for reflection, and a short reference is made to the theory of non-reflecting films. Some teachers will consider it unfortunate that in a book otherwise up to date the Maxwell equations are given in terms of Gaussian electrical units and not in the M.K.S. units now used in the standard texts on electromagnetic waves.

III. *Radiation and Spectra* (80 pages) deals with 'black-body' radiation, including a proof of Planck's law, optical line and band spectra, magneto-optics, X-ray spectra, colorimetry, Rayleigh and Raman scattering.

IV. *Experimental Optics* (90 pages) gives theoretical and practical detail of 24 carefully selected experiments for a laboratory course. Subjects of these include: aberrations of lenses; plane and concave gratings; Michelson and Fabry-Perot interferometers; spectrophotometry; X-ray spectrometry—a wide range; and a useful note is given on the photographic process.

Numerical problems, some of them novel and suggestive, are appended to each chapter; tables of constants are given in an appendix.

E. O. HERCUS.

Plastics

Elastomers and Plastomers—Their Chemistry, Physics and Technology. Volume 3. Testing and Analysis; Tabulation of Properties. Edited by R. Houwink. (New York-Amsterdam-London-Brussels: Elsevier, 1948. 174 pp., 48 text-figs., 36 tables. 6¾" × 10".) English price, £1. 5*s*.

This volume forms part of Elsevier's Polymer Series. It contains three main sections: methods of physical testing, qualitative and quantitative chemical analysis, and tables giving the properties of the more important elastomers and plastomers. It is unlikely that many individuals will be equally interested in all of the sections; but the book should be in all libraries dealing with plastics, for it brings together much information which previously was scattered.

The chapter on methods of testing, written by J. H. Teeple of the Celanese Corporation of America, is far from being a bare recital of testing procedures, and would form an excellent introduction to this most important aspect of plastics for those who enter the field as chemists without engineering training. Stress is laid on the conditions which affect test results, and the types of results obtained with different materials. Naturally the A.S.T.M. tests predominate; but the comparison and correlation of methods used in different countries, while not neglected, are disappointing.

A. G. Epprecht of Zurich contributes the chapter on the chemical analysis of polymers, which is probably the most widely useful part of this volume. He has not achieved the ideal of reducing qualitative analysis of plastics to one comprehensive system, but he gives the next best—a relatively simple systematic procedure backed by two or three less complete schemes. Among these latter is the 'burn and smell' table of Nechamkin, and the solvent separation schemes of E. J. Fischer. The setting-out of the second table of this (pp. 88-9) is so poor that it will puzzle most chemists. A classification of plastics according to the presence of N, Cl, S and P is too elementary to justify its inclusion. Full details are given for the quantitative analysis of a mixture of phthalic, abietic and fatty acids and glycerol, as an example of a 'qualitative' analysis. A considerable proportion of the chapter is devoted to the quantitative analysis of individual polymers.

The third section of the book has been compiled by B. B. S. T. Boonstra and J. W. F. van't Wout, of the Rubber Foundation at Delft, and H. Houwink of Wassenaar. The object of the tables is to express in numbers the most characteristic properties of materials representative of the main groups. The figures for plastomers are largely taken from various published charts of properties, but those for elastomers have been obtained at the Rubber Foundation at Delft. Fifteen types of elastomers, giving thirty-four materials with specified compounding recipes, are listed in six double-page tables, with their mechanical, thermal, electrical, physical, ageing and swelling properties and their chemical resistance. The eleven tables for plastomers deal with sixty-five materials of some twenty types, and cover mechanical, thermal, electrical, physical, optical, chemical and moulding properties. In addition there are two tables of the properties of seventeen types of fibres.

Throughout the book there are many spelling errors and minor slips, as on page 74 where some lines of type have been mixed. Reference 58 on page 67 quotes an A.S.T.M. test without a number or title, and number 69(c) on the same page refers to a C.I.O.S. report by numbers which merely classify the industry but do not specify the report. Such mistakes are unimportant, however, and Volume 3 of Houwink's *Elastomers and Plastomers* deserves to be widely known among those working on technical aspects of plastics.

J. S. Fitzgerald.

Spectroscopy

An Introduction to Molecular Spectra. By R. C. Johnson. (London: Methuen, 1949. 296 + xiv pp., 151 text-figs., 8 plates. 5¼" × 8½".) English price, £2 net.

There are some books which are intended for the serious student who is not content with a merely casual survey of his subject but will be satisfied only by a thorough examination of every thread and fibre of its intricate structure. Johnson's *Introduction to Molecular Spectra* belongs to this class. The author is to be congratulated on the excellence of his arrangement, the extent of his treatment of the subject, and his attractive and illustrative style. If there are some mistakes in the context, they will be lost in all the rest, which is beyond question one of the most accurate and authoritative treatments of any branch of chemical physics that has been published in recent times. However, the work is not for the beginner. Nor is it for anyone who wants to find out how the considerable formulation derives from quantum mechanical considerations. That will be left for more theoretical texts. This book deals mainly with analyses of band systems which have generally been obtained from experimental data of great accuracy.

The writer plunges straight into a discussion of bands, their general and fine structure, and the origin and nature of the multiplicity which is usually implied but not always explained in modern texts. The interaction of electronic and vibrational energy, and the linking together of electronic and rotational motions, are shown to account for the changes in value of the $\Delta\nu_e$ doublet interval throughout the system. The

distribution of intensity among the bands has been made the subject of a special chapter, as well it should be: previous writers have not always given it the detailed attention it deserves. The U(r) functions of Kratzer, Morse and Rydberg have been well represented, and the striking agreement between the Morse and Rydberg functions is shown particularly in the case of nitrogen. In the chapter on the dissociation of molecules there is an interesting question: why cannot a molecule with an electric moment absorb enough vibrational energy to dissociate, without first having to undergo an excitation to a higher electronic level? The writer has not attempted to answer this question in any convincing way, but it is known that acquisition of large amounts of vibrational energy, by large increases in the quantum number, ν, in the ground state, is found to be experimentally impracticable. We are reminded of the days when the Radiation Theory of Catalysis was being demolished by careful experiments showing the ineffectiveness of infra-red radiation for chemical decomposition.

Detailed consideration of the electronic states of molecules, analyses of rotational fine structure, and many Fortrat diagrams shown in great detail and drawn with great care, are special features of the succeeding chapters. The isotope effect and the influence of magnetic fields (Zeeman and Paschen-Back effects) are discussed in special chapters.

The greater part of this work is devoted to diatomic molecules, but attention has been given to some of the simpler polyatomic molecules, principally their infra-red and Raman spectra, and their modes of vibration in special cases. The writer has not attempted a description of the characteristic absorption spectra (visible and ultra-violet) of the more complicated molecules.

The last chapter is concerned with some applications of spectroscopy to astrophysics, stellar and planetary spectra, chemistry and biochemistry, but on account of its limited scope it might well have been omitted in a book so eminently devoted to more fundamental matters.

There are one or two quite noticeable printer's errors: page 42, $^4S + {}^4D$ should read $^4S + {}^2D$; page 45, $A^2\Sigma$ should read $A^3\Sigma$; page 111, Plate III should read Plate IV.3.

T. IREDALE.

Technology

TEXTILE LABORATORY MANUAL. By Walter Garner. (London: National Trade Press, 1949. 478 pp.) Price, £2. 6*s*. 6*d*.

The object of the book is to provide in one volume sufficient information for the performance of all the usual analytical and testing requirements of a mill laboratory. It consists of twenty-one chapters on a wide range of subjects, which include the structures of the various fibres; yarn and fabric properties; insulation; detection of metals; colour; evaluation and analysis of dyes; detergents; textile oils and chemicals; biological, optical and viscosity methods; water supplies and effluents; and statistical methods.

As would be expected in a publication of such type, certain subjects in which the author is probably more experienced receive better treatment than others. The chapter on textile oils is probably the best-balanced in the book, adequately covering all the usual tests required by the mill chemist. The chapters on insulation and colour might be considerably shortened.

Physical testing of yarn and fabric is fairly well covered; it might be improved in future editions by mention of strain gauge equipment and of the Schiefer and Stoll abrasion machines, which are widely used in America. References to a 'cellulosic interscale elasticum' in wool (pp. 5 and 421), removed when the wool is shrinkproofed with alcoholic alkali (p. 17), are without experimental proof and appear to be the 'personal opinions' of the author (p. 292). The comments on resin treatment to produce unshrinkable wool (pp. 17 and 18) are misleading. Not all resins are removed by boiling in 0·5% hydrochloric acid, and there is no production of an 'impervious layer of varnish' around the fibres in any of the usual processes. The optimum residual grease content of scoured wool, given as 0·4% or less (p. 353), is probably too low.

More care could have been taken in the preparation of the text, which contains names such as 'Rimington', 'Tootal', 'Duerden' and 'Schiefer' spelt incorrectly. Other errors noted are in the spelling of 'arginine' (pp. 2 and 3) and 'glutamic acid' (Figure 3), and in the formula for Eulan (p. 420). Many references are given, but there is little order in their abbreviation and location. The book is well illustrated throughout with excellently reproduced diagrams and photographs of equipment.

M. LIPSON.

Book Notice

A METHOD OF REMOVAL OF ORGANIC IMPURITIES FROM A WATTS TYPE NICKEL PLATING SOLUTION. (D.R.L. Information Sheet No. S.5. Two pages duplicated typescript.) Obtainable from Defence Research Laboratories, Private Bag No. 4, Ascot Vale, W.2, Victoria. Free.

The presence of organic matter in nickel solutions can give rise to various defects in the nickel deposit, depending on type and concentration of organic impurity. The method given has been found suitable for treating Watts type nickel solutions. Potassium permanganate is added to oxidize the organic matter and to adsorb some of it on the resulting precipitated manganese dioxide.

The Australian Journal of Science

Vol. 13 21 February 1951 No. 4

Medical Research

SIR HOWARD FLOREY

II. The John Curtin School of Medical Research in the Australian National University*

What exactly is it proposed to do in the John Curtin School of Medical Research? There is a large choice as to what may be done under the heading 'Medical Research'. Clearly, no medical school—or research institute—can cover all fields. The objectives at Canberra are therefore restricted and clear-cut. They are to produce first-class laboratories and staffs in the most important basic medical sciences. Nothing else will be attempted at the present time, though of course the future may hold further developments. Plans have been prepared for setting up departments of Physiology and Pharmacology, Biochemistry, Medical Chemistry, Microbiology, and Experimental Pathology, and consideration is being given to Biophysics. The heads of four departments have been chosen. The Department of Medical Chemistry is established in the Wellcome Research Institution in Euston Road, London, under the direction of Professor Albert, who has now working with him some members of his permanent staff who will go to Canberra, and a Ph.D. student. It is a first-rate department and only awaits space for the rapid expansion which in Medical Chemistry is possible because of the supply of good chemists. Professor Albert has already published work and expects to have a book from the press in a few months.

Professor Ennor (Biochemistry) is housed in the Commonwealth Serum Laboratories in Melbourne, is actively engaged at his researches, and has young people working with him. Several papers have already been published, and active steps are being taken to expand the research team to the maximum, having regard to the space available.

Professor Fenner (Microbiology) who returned from eighteen months' work in the U.S.A. and Great Britain at the beginning of this year, is installed in the Walter and Eliza Hall Institute, and is collecting assistants and colleagues in so far as limited space permits.

Professor Eccles (Physiology) has recently been appointed, and will organize his research workers in Dunedin, where he is at present Professor of Physiology, before the transfer to Canberra.

The central idea is to choose men who are masters of their subject and who are likely not only to make discoveries themselves, but to assemble around them other research workers of a high calibre and to train students at least to the Ph.D. standard.

These departments are to be knit together by being housed in one School building with a common administration. Until buildings are erected, the departments are coming into being wherever convenient, and such staff as can be accommodated is being engaged; so that when buildings are ready at Canberra there shall be no needless delay before the departments are actively functioning there.

The buildings are being planned to be good and to have facilities such as might be expected in a modern laboratory in Great Britain or elsewhere. It is hoped to provide all necessary facilities for the type of work likely to be undertaken in the various departments in the next few years. When fully established, fifty or perhaps a few more research workers, paid for by the University (some of whom will be students in training), will be accommodated together with adequate technical assistants who may number fifty or more; and space has been provided for visitors from other laboratories. The training of research workers will in the first instance be on the apprenticeship plan and at present no set 'courses' are envisaged.

* The second portion of a lecture delivered in the University of Melbourne on 9 August 1950. The first portion, dealing with the History of Medical Research, was published in This JOURNAL, *13*, 61 (21 December 1950).

Function of the School

It is said from time to time that the National University will drain all the best men from the State universities. Is this likely? I think not, at least as far as the medical sciences are concerned; for it is impossible at the present time to increase the size of the departments beyond that for which they are planned, and after equilibrium has been reached there will be relatively few additions to the staff. The indications at present are that a substantial proportion of the staff will be those who would have stayed abroad and not taken up jobs in Australia at all.

The outlets for the trainees (the Ph.D. students) are, in the first place, the Australian State universities and institutes, and in the second place posts abroad. I very much hope that some will return to clinical medicine. This last remark raises the question of the best form of training for those doing clinical work. Fundamentally, at some stage, they must be taught experimental methods—as physiologists, experimental pathologists, biochemists, and so on. This is, of course, common practice in America, where one may find the professor of medicine making significant discoveries in bacteriology; as for example Miller, Professor of Internal Medicine at Chicago, and of his collaborator Miss Bohnhof, on the development of bacterial resistance to penicillin and on strains of organisms which, originally apparently sensitive to the action of streptomycin, not only become resistant to it but come actually to need it for their growth.

In Great Britain we are alive to the grave deficiencies at present in the numbers of those who have received sufficient grounding in the scientific approach to clinical research. A scheme is at present being prepared by the Medical Research Council, the central point of which is that holders of fellowships should return to laboratory work for two years or so after having some clinical experience, before undertaking to investigate the difficult problems and material presented by living patients. It is hoped in this way to extend and to raise the standard of clinical research.

If the conditions for research in the State universities and institutes are not improved there will be a steady leakage of some of the best people to other countries—unless, of course, the unstable condition of world politics completely alters the picture. Though some of the people trained at Canberra may eventually find their permanent homes abroad, it is hoped that visitors will frequently come from abroad to work in Canberra. There is already much good will for such proposals, provided that the standard of work is sufficiently high and the equipment sufficiently good. I should hope that in a few years there will be a constant flow of visitors, who will remain some years, from Great Britain, India, Pakistan, and possibly from Canada, the U.S.A., and elsewhere. It is also hoped that the research workers at Canberra will be invited by the State universities to visit and give courses of lectures on special subjects, and from time to time to take part in the laboratory work of the State universities.

I firmly believe that, if a broad view is taken of medical research in Australia, the establishment of the John Curtin School of Medical Research will in twenty-five years be found not only to have produced first-class research laboratories, but to have acted as a stimulus to other Australian institutions. Whereas now there are few outstanding laboratories, then there will be many, and where there are now few workers with the time and the inclination to do steady research work there will then be many more, and the harvest of discovery will be correspondingly great. Australia already has a high reputation for its veterinary and agricultural researches, and in certain branches for its medical research, conducted mainly in research institutes. I cannot see why, with the number of able young men in the universities of this country, she should not be able to compare herself favourably in medical research with, shall we say, Sweden, which has a slightly smaller population and certainly not so many resources.

The successful working of the Medical School of the Australian National University is entirely dependent on good relationships with the State universities, for it is to the State universities that the National University must look for its young research workers. There is little doubt that the medical and science students turned out from the Australian medical schools are well trained, and that they can be considered to be the equal of those who graduate from similar courses elsewhere. A small proportion

are first-rate and have no difficulty in holding their own with the best graduates whom they meet in Great Britain.

Value of Universities

An evil of the times to which apparently Australian medical graduates are particularly prone has recently been called 'diplomatosis'; that is, a passionate belief in the value of securing diplomas and 'swotting up' innumerable textbooks and so on. This is no doubt conditioned by the hope of getting future congenial appointments, but it is destructive of any thoughtful approach to medicine among the young, and must stifle much initiative which might lead able men to embark on some coherent research. Probably the same disease is becoming very prevalent in Great Britain. The cure for it is not immediately apparent; perhaps some research should be done on it. In spite of this distressing disease there seem to be a number of good graduates capable of doing research and we hope the National University will give some of them the opportunities they want.

There is apparently no dispute among those in the universities that all are deplorably short of money, that they are overcrowded, that inadequate staffs struggle to cope with the vast burden of undergraduate teaching, and that technical assistance is extremely scarce. It is unfortunate that Australian universities, good as they are and with great records behind them, have apparently not yet succeeded in sufficiently impressing on governments, and on those controlling large sums of money, that even from the basest utilitarian point of view they pay immense dividends to the community in many ways, and that they should be lavishly supported. It is true that in Great Britain general recognition of the great value of the universities has been slow in coming, but one of the few good things which came out of the last war was a quickening of the appreciation by all political parties, and by the public, that the safety of a country depends to an increasing extent on scientific research such as was conducted particularly, but by no means exclusively, by physicists during the last war; and that research is the basis of much prosperity and of the people's health. Further, it is now better appreciated that the universities are great reservoirs of highly trained individuals who, whatever branch of learning they have studied, prove invaluable in numerous administrative and other jobs needing trained intelligences. It has become obvious to all that it is the universities who train the chief civil servants and the key scientific men of Great Britain.

This awareness of the value of universities has been translated by the Government into hard cash, and it is correct to say that all universities in Great Britain are now being cared for much more sympathetically than they were ten years ago. It would, of course, be absurd to suggest that the Australian universities are not highly thought of by the community, and that they have not been supported by many public-spirited donors and by the State, but they are not esteemed enough and they are lagging behind the standards they have a right to achieve and which are being achieved elsewhere.

When I say they should receive adequate financial support, I do not mean sufficient increased finance to enable a few more teachers to be hired who will turn out a few more graduates, but I mean finance to see that the staffs of the universities are adequately paid, have leisure to think without being too tired, to do research as a right and not as something eccentric pushed in to fill a few odd moments between teaching, and to be adequately housed and equipped. My impression is that the most pressing need, at least as far as medicine is concerned, is to finance people doing research much more adequately and on a better basis than annual grants.

Modern research, which uses increasingly complicated methods to push its enquiries ever deeper into biological and physical phenomena, is expensive relative to its cost last century; but if the results of medical research carried on throughout the world can be viewed as a whole, the gains from relatively trivial expenditure are immense. Australia, I am convinced, has many men capable of doing first-class medical and other research. Think whether their environment and opportunities are such that they do Australia credit.

Perhaps I could summarize by saying that medical history and the state of medicine at the present time teach us that the greatest advances occur when experiment is wedded to accurate observation. Observation alone is

likely to produce little. Medical research needs more than lip service; it needs money, hard work, hard thinking and good organization. Given the good will, I fail to see why the new and the old universities of Australia coming together in a kind of symbiosis should not carry along real medical research, both in the basic sciences and in the clinical fields, to heights not previously reached in Australia, and so make their just contribution to the world's store of knowledge.

To end, however, on a note of pessimism, I sometimes wonder whether Australia now possesses the élan and energy to make use of her abundant natural and human resources.

Higher Technological Education*

The arguments of protagonists for the establishment of the New South Wales University of Technology have laid stress upon the lag of development of technological education at tertiary level in British countries, compared with developments in Europe and America (Brown, 1949). The relative decline of British production per head of population, compared with a country such as Switzerland, has been attributed to this cause. As long ago as 1885 Lord Playfair, as President of the British Association for the Advancement of Science, forecast a decline in Britain's manufacturing supremacy, on the grounds that 'Oxford and Cambridge are still far behind a second-class German university' and that 'in Great Britain we have nothing comparable to the great technical college of Zürich in Switzerland'. Playfair, in fact, had even in 1852 pointed to existing industrial instruction in Europe and had foretold that British industry would suffer a decline because of insufficient and poorly trained technical men. It was not until 1894 that the Mechanical Science tripos was introduced at Cambridge; English universities still pay little attention to the many fields of Applied Science other than engineering and medicine.

Realization of shortcomings in the war of 1914 led to greatly increased attention paid to scientific research by British industry and Government. Yet in the succeeding twenty-five years Britain continued to recede technologically, relatively to the defeated Germany, to Switzerland and to the United States of America. Her eminence in fundamental scientific research was well maintained, but the advantages accrued from the application of British basic discoveries were reaped by other nations. This was in spite of the expansion of the National Physical Laboratory; the foundation of the Department of Scientific and Industrial Research in 1915; and encouragement of the establishment of Research Associations by groups of manufacturers.

It is pointed out that little had been done to advance technical education at the same time. The beginnings of growth of technical education in Britain may be traced from the inauguration of the Mechanics Institute in Glasgow in 1804. Birbeck founded the Mechanics Institute, in 1823, which later became the Birbeck College of the University of London. The first government grant to a night school was made in 1857; but although the President of the Department of Education stated that he would be glad to see such classes more extensively established, he doubted whether they should be an expense of the State. The establishment of the Regent Street Polytechnic by Quinton Hogg in 1880 set the pattern for the spread of technical education through Britain. At the tertiary level, however, education in applied science was fostered mainly through faculties added to the academic universities.

Europe

In Europe, especially since the 1880's, *Technische Hochschulen*, granting degrees with university status, have flourished beside the traditional universities with their four faculties of theology, law, medicine and philosophy (science). Both are supported by the State and are self-governing, and they are of similar prestige and status. Among the chief of these technological institutions are those at Delft, Zürich, Trondhjem, Charlottenburg and Geneva. The Federal Institute of Technology at Zürich has about 2,000 full-time students and 700 part-time, with one teacher to each eight students. A student takes courses in economics (or law), languages, philosophy and history; and his final examination involves two branches outside of his own sciences. The Swedish universities do not have faculties of engineering, but the technical schools are entered by competitive examination at about twenty years of age. Compared with technological training in England, the courses in these schools are 'more specialized in their object, more catholic in their subjects'. A Belgian may legally style himself *Ingénieur Civil* only after a five-year course at one of four approved universities or at the Faculté Polytechnique de Mons. Entrance qualification normally requires an extra year of study between high school and university.

By comparison with the Continental System, Patrick Johnson states in an article in *The Times Ed. Supp.* (1950, p. 79), that 'the British system is at present neither delivering the goods nor is constitutionally capable of so doing. Whenever engineers of ostensibly equal qualifications and experience are brought

* Following the article on *The N.S.W. University of Technology*, This JOURNAL, *13*, 3 (August 1950).

together from Britain and other industrial countries, one cannot fail to notice that, while the British are academically equal, there is a marked disparity, against us, in the more generalized ability. . . . The mark of the product of a good Continental school of technology is a grasp of affairs . . . . He is more able to relate his engineering to life . . . . He can argue more consistently and clearly, write better, make his case more forcibly to the enterprise he serves, and comprehend the social purport of his service . . . . He has been educated as well as taught.'

America

In the United States of America, on the other hand, the technical faculties have assumed more status in the universities than they have in Britain, while at the same time there have grown such centres of technological culture as the Massachusetts Institute of Technology and the California Institute of Technology. Compared with Britain, two features affecting technological education at the tertiary level are significant in the U.S.A.: the far greater proportion of people who proceed to higher education (however dubiously some of us may evaluate it); and the flexibility of vocational employment and the social pattern which make it normal for university graduates to turn to non-professional occupations if they so prefer. It is estimated that the number of university graduates per head of population who are engaged on administration, sales and executive work, for example, is about four times greater in U.S.A. than in England. The United States, with a population three times that of Britain, have a university income totalling 97 million pounds, compared with six and a half million pounds in Britain. In 1938 there were over a million students in American universities, 50,000 in British. The conclusion is that in Britain—and in Australia—industry and technology receive relatively few men with university training.

The scheme of education in which the pattern is provided by the Massachusetts Institute of Technology, which opened in 1865, had been propounded during the previous twenty years by William Barton Rogers, then professor of natural philosophy in the University of Virginia. He preached the dignity and prestige of the practical professions, for which vocational studies give the student satisfaction in useful achievement. He believed that there is an educational gain in building a curriculum around a professional objective: that the motivation derived from the student's professional interest can be capitalized to provide a thoroughness and discipline of great educational value. He believed in learning by doing, being one of the pioneers of education by systematic use of the laboratory method: he was not content that the student should acquire knowledge, but believed that education meant the study and mastery of Method, and that it thrives best in the creative atmosphere of the scientific method. M.I.T. today includes schools of science, engineering and architecture broadened by work in the humanities and the social sciences; with a graduate school of research which is viewed not as an end in itself, but as part of the educational process; and with contacts made with industry for the purpose of cross-fertilization. It has been described as 'a university limited in its objectives but unlimited in the breadth and the thoroughness with which it pursues these objectives'.

Britain

It was argued by R. H. Quick, an educationist of the Victorian age, that the Renaissance had been not a blessing but a curse to English education, in that it elevated learning above doing. It thus left a legacy of false educational values and of detrimental social distinctions. Lord Cherwell states (*The Times, Ed. Supp.*, 1950, p. 59):

> It is difficult to see why a man should be said to have enjoyed a liberal education if he knows something about the classics and very little about science and engineering; whereas he is reviled as a mere technologist if he knows about science and engineering and very little about classics. Merely because one branch of learning was the more important in the sixteenth century does not prove it to be superior to other branches which lie at the root of all our production in the modern world . . . .
>
> Because some centuries ago a university was a place in which men were taught theology, law, medicine, and the arts, this is not a sufficient reason to reserve the name for institutions confined to these particular subjects. An establishment in which history, economics, mathematics and science, and the vast variety of engineering subjects are taught has just as good a right to the title. If we cannot teach everything everywhere I do hope the universities will not jealously confine this noble name with its great traditions to those places where only the ancient faculties exist, and insist on some pejorative appellation for the others in which modern subjects have replaced certain of the more traditional forms of knowledge. What counts is whether an institution is a place of learning, not which particular subjects are practised.

In 1944 the British Ministry for Education set up a Special Committee, under the chairmanship of Lord Eustace Percy, on *Higher Technological Education*. Its terms of reference were:

> Having regard to the requirements of industry, to consider the needs of higher technological education in England and Wales, and the respective contributions to

be made thereto by universities and technical colleges; and to make recommendations, among other things, as to the means for maintaining appropriate collaborations between universities and technical colleges in this field.

The Committee submitted its report in 1945 It stated that 'the position of Great Britain as a leading industrial nation is being endangered by a failure to secure the fullest possible application of science to industry'; and that 'the experience of war has shown that the greatest deficiency in British industry is the shortage of scientists and technologists who can administer and organize, and can apply the results of research to development'. It stated that existing courses in universities and technical colleges were not qualitatively sufficient:

> We recommend, therefore, the selection of a strictly limited number of technical colleges in which there should be developed technological courses of a standard comparable with that of university degree courses. . . . A very important function of these colleges would be the provision of post-graduate courses in special branches of technology . . . intended for their own graduates or for graduates from universities, and for men who have been in industry for some time.

The report made detailed recommendations as to regional and central organization, recruitment and qualifications; it recommended that management and administration studies should be included; and drew attention to the desirability of teachers taking active part in industry from time to time, and of industry releasing senior members to give advanced courses from time to time. The report also stated:

> Neither university nor technical college courses are designed of themselves alone to produce a trained engineer. All such courses have to be considered as part of a longer course of combined academic study and works practice, extending over at least five or six years. The works practice should be as carefully planned as the academic study, and the whole should be planned by co-operation between the educational institution and the industry concerned.

The Parliamentary and Scientific Committee of Great Britain afterwards issued reports on *Scientific Manpower* (the Barlow Report); on *Universities and the Increase of Scientific Manpower*; and on *Colleges of Technology and Technical Manpower*. The following are extracts from these reports:

> This country led the world in discovery and invention, and consequently in industrial competition for the world's markets, until about 1850. After that date, foreign competitors seriously challenged, and in certain cases surpassed, our manufacturing position, by the rapid exploitation of modern inventions and discoveries made, but not applied, in our own country.
>
> It seems reasonable to seek the explanation in those countries which have challenged our industrial supremacy. It is found that they all possess recognized technical education systems in which they have great faith. Their technical universities are buildings of magnificence and beauty . . . Indeed, the technical university may sometimes overshadow the local academic university in importance. In this country we possess no colleges of technology comparable in size or status with some of the technical universities abroad.
>
> Our industrial decline cannot be attributed to any inherent national inaptitude. . . . With adequate provision for higher technological education, this country could again secure the benefits of our technical and scientific achievements in the development of our industries, reach equality with our competitors in technical manpower, and regain our pre-eminence in the markets of the world.
>
> In the past there has prevailed in certain quarters an unjustified belief that it was not appropriate to extend university recognition to technological studies, on the ground that the content of the courses did not warrant it. However, it is now more widely appreciated that the study of a technology necessarily involves a thorough groundwork in the pure sciences. . . . It has been contended that students should attend a pure science course and should acquire their knowledge of technology in a post-graduate year. However, an adequate study of many branches of technology cannot possibly be made in a post-graduate year. . . . These branches of technology, with the necessary fundamental sciences, must be included in the undergraduate courses.
>
> If men and women are to be attracted to the courses in the Colleges of Technology, the status of those colleges must be similar to that of the universities, and they must develop into responsible institutions performing a national function. . . . It is essential that on successfully completing a course, the student should receive the award of a technological qualification which will correspond with the university degree. The award must have an accepted currency, both nationally and internationally, especially in university, industrial and commercial circles.

The question of higher technological education is alive in Britain at present and is the subject of discussion by scientists, technologists, educationists and administrators. The Minister for Education three years ago referred

the matter to the National Advisory Council in Education for Industry and Commerce, which has since been consulting universities, technical colleges, local educational authorities, professional institutions, and industry. In an endeavour 'to induce the Government to disclose their attitude', Lord Calverley initiated a debate on the subject in the House of Lords on 14 March 1950. (At the conclusion, he commented that 'the House knew as much as they did before the debate'.) The question was also dealt with in debates in the House of Commons on 4 and 5 May. Reports and proposals have been made by the Institute of Physics, the Federation of British Industries, the Home Counties Regional Advisory Council for Higher Technological Education, the Association of Technical Institutions, the Association of University Teachers,* and others. A special conference was held in the rooms of the Royal Society, under the chairmanship of Sir Henry Tizard, on 27 March 1950. It was arranged by the Advisory Council on Scientific Policy and included, besides the president and representatives of the Royal Society, representatives of the Ministry of Education, the University Grants Committee, the Advisory Council on Scientific Policy, university departments of applied science, and a number of others.

Five main lines of solution have been suggested:

1. That industry should take university graduates of broad education and should itself organize specialized training for them.

2. That the universities should expand their technological faculties or should develop auxiliary institutions attached to themselves.

3. That selected technical colleges should be upgraded to become technical universities (as recommended in the *Percy* report).

4. That a professional institution, such as a Royal Society of Technology, be founded to establish national qualifications (such as 'licentiate', 'fellow' and 'member') and to approve courses.

5. That two or three universities of technology should be established as new, independent institutions, each with about 3,000 students, to serve the whole nation.

During the five years after the war, the universities of Great Britain, on the average, about doubled the number of students and staff in their technological departments. (There were 10,916 technological students in the year 1949-50.) It is contended by some authorities that the demand for graduates does not go far beyond this supply at present, but that a difference in quality is what is needed. The immense mass of equipment, however, and the manifold establishment of staff, that are required for modern technological education at high level (as evidenced by overseas establishments) are uneconomic unless used by a large number of students, say between 2,000 and 4,000. The University Grants Committee states that it is 'satisfied that it is for the good of the whole university that technologists should form part of the student body'; but it is evident that 2,000 technical students could not be absorbed by any British university, except that of London, without overbalance. Moreover, it is doubted that the casual contacts of the university engineering student with the arts student, 'over an occasional cup of tea or cocoa', save him from over-specialization. 'One grows exasperated to hear claims on behalf of the humanizing influence of ordinary universities on technologists' (*The Times, Ed. Supp.*, 1950, p. 437). The alternative is the deliberate infusion of humanistic and social studies into the curriculum and life of the purposive technological university.

It is maintained that the technical colleges, which sometimes tend to schizophrenia in their endeavours to combine tertiary (diploma) courses in technological education with trades courses in technical training, could not attend to the undertaking of university functions without detriment to their essential function of providing the trades courses. 'A technical college, reconstituted and regraded to teach technology, would *ipso facto* be deflected from its original and proper purpose' (*Nature*, *165*, 738). Projects for technical colleges to cost £5,700,000 were started in Great Britain in 1949, and further projects to cost £10,000,000 were in preparatory stages. Perhaps the most difficult problem is that of securing science teaching staff, whether for school, college or university.

It is generally agreed that the urgent need for trained technologists at the present time may best be satisfied by looking to the existing universities, and perhaps to certain technical colleges, as a short-term policy, rather than incur a delay of, say, five years while new institutions become productive. It seems likely, however, that long-term policy will be promoted by the establishment of at least one technological university in Great Britain, while

* The Association of University Teachers, at a council meeting held in December 1949, passed the following resolutions:

1. That technological education and training is a proper and desirable part of the work of a university.

2. That technological progress in the United Kingdom can best be secured by the expansion of the existing facilities and departments of technology in the universities and the building up of new ones in the universities when necessary.

3. That no branch of technology should be excluded from the work of the universities.

4. That, should any institutes of technology be set up, they should be sponsored by existing universities and come under the University Grants Committee.

The council authorized its executive committee to take action necessary to secure the implementation of this policy.

the technological faculties in the existing universities, though they may be modified in their functions, are still likely to continue. The proper relationship and interplay between the two would become clear only after experience. The proposal to establish a quick alternative or auxiliary solution of the problem is being faced by many objections.

A factor which had not previously entered into the British discussions was mentioned in a leading article in *The Times, Ed. Suppl.* (1950, p. 123):

> There can be little doubt that some of the defects of the British system of producing engineers and applied scientists are caused in the schools. If a technical university were established in England and fed from the science 'sixths' of grammar schools as they now are, the average products of the new institution might still be behind their Continental opposite numbers. Incidentally, of course, the universities and not the schools are to blame for this, because of their scholarship and entry requirements. The claim that one-third of a sixth-form science pupil's time is given to general cultural study is more often substantiated in the time-table than borne out in practice. Setting aside the rare exceptional mind, which nothing can harm, the average boy or girl is impoverished for life by being allowed to do virtually nothing more than science for the last two years at school. No university, technical or other, will overtake the damage done. It is a mistake not made on the Continent. To succeed, a new technical university would have to maintain a stricter definition of liberal education than its drifting elder brothers and express this definition in its entrance regulations; by this means it might improve the schools.

New South Wales

It is with the guidance of the report of the Percy Committee and that of the Parliamentary and Scientific Committee, together with U.S.A. reports such as that of the President's Scientific Research Board (*Science and Public Policy*, 1947) and the President's Commission on Higher Education (*Higher Education for American Democracy*, 1947) that the concept and detail of the New South Wales University of Technology took form. Although men of science in Australia may regret some of the features of the process of its establishment, and especially the numerical weakness of their representation among the governmental and industrial influences that constitute its advisors and councillors, they welcome Australia's eighth university as an unique conception of great potential value, not only to the national welfare but to the advancement of science.

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- Australian Industries: New Call for Technical Training. Page 41.
- N.S.W. Technical University: Laying the Foundation Stone. Page 213.
- The Case for the Technical University:
  - I. British Weakness in Applied Science. By Michael W. Perrin. Page 40.
  - II. Demands of Modern Engineering. By Lord Cherwell. Page 59.
  - III. Engineering Education on the Continent. By Patrick Johnson, Managing Director of Power Jets (Research and Development) Ltd. Page 79.
  - IV. Upgrading of Colleges a Doubtful Policy. By H. Lowery, Principal of the South-West Essex Technical College. Page 99.
  - V. Higher Technological Education in America. By James R. Killian Jr., President of the Massachusetts Institute of Technology. Page 119.
- Technology (leading articles). Pages 123, 437.
- University Technologists: View of the Grants Committee. Page 44.
- Royal Society of Technology: Technical Institutions' Policy. Page 162.
- University Training: Status of Technical Colleges. Page 202.
- Technical Universities: Training Experts for Industry. Page 238.
- Provision of Technology (letter from H. V. Lowry). Page 345.
- Places of Higher Technology: Graduate Standards (letter from R. S. Hutton). Page 393.

The following articles have appeared in recent issues of *Nature*, Volume *165* (1950).

- Higher Technological Education in Great Britain (report of the Royal Society's special conference, 27 March). Page 627.
- Technological Education in Great Britain (leading article). Page 737.
- Technological Education in Great Britain (letter from T. J. Drakeley). Page 940.
- Technological and Technical Education in Great Britain (leading article). Page 943.

Australian Science Abstracts

After consideration of the replies received to the inquiry made as to *Australian Science Abstracts* (This Journal, *12*, 61, xxvi, October 1949), it has been decided to discontinue abstracts in the physical sciences but to continue abstracts in Botany, Zoology, Entomology, Geology and other sciences which have a topographical basis.

Australian National Research Council

Executive Meeting, November, 1950

Pan-Indian-Ocean Science Congress

THE Australian National Research Council accepted the invitation of the Government of India to send a delegation of eight members to the Science Congress at Bangalore in January 1951. The following were nominated as official delegates:

- Professor A. D. Ross, Department of Physics, University of Western Australia (Leader)
- Professor A. P. Elkin, Department of Anthropology, University of Sydney
- Dr. A. B. Walkom, Director of the Australian Museum, Sydney
- Professor V. M. Trikojus, Department of Biochemistry, University of Melbourne
- Professor S. W. Carey, Department of Geology, University of Tasmania
- Mr. A. J. Millington, Institute of Agriculture, University of Western Australia
- Dr. E. G. Bowen, Chief of the Division of Radio Physics, National Standards Laboratory, Sydney
- Mr. A. F. Thyer, Bureau of Mineral Resources, Melbourne.

In addition, Mr. B. E. Butler of the C.S.I.R.O., and Mr. M. A. Condon of the Bureau of Mineral Resources, being in India at the time on other business, were to attend the Congress as observers.

A.N.R.C. General Meeting, May 1951

The following was provisionally approved as the Agenda for the general meeting of the Council to be held in Brisbane in May 1951:

1. Pan-Indian-Ocean Science Congress.
2. The conservation and protection of fauna in Papua and New Guinea.
3. Suggested register of Pacific scientists.
4. The Commonwealth Committe regarding Universities: Discussion.
5. The more rapid election of members to the A.N.R.C.
6. The location of the executive headquarters of the A.N.R.C.
7. Organized visits of scientists, sponsored by the A.N.R.C., to neighbouring territories.
8. The Australian Journal of Science.

Members are being urged to forward to the Joint Honorary Secretary items they would wish to be placed on the Agenda.

International Astronomical Union: General Assembly

The following members of the International Astronomical Union from Australia will attend the General Assembly of the I.A.U. in Leningrad and Pulkovo from August 1-8 1951:

Dr. R. v. d. R. Woolley
Dr. A. R. Hogg.

Dr. R. v. d. R. Woolley will represent Australia on the Nomination Committee.

Executive Meeting, December 1950

Australian Journal of Science

There was considerable discussion on the *Australian Journal of Science* when the Editor, Dr. R. L. Aston, was present by invitation. It was felt that steps should be taken to relieve the Editor of some of the duties which he had been called upon to do. It was recommended that two young Assistant Editors should be appointed and that each State Division should appoint an Associate Editor to collect copy for the Journal and generally to further its interest. Terms of reference for the Editorial Committee were drawn up subsequently to the meeting and it is hoped that these will be confirmed at the February meeting.

The actual date of publication of each issue of the Journal is to be shown on each issue. It is proposed to issue a Jubilee issue of the Journal about the middle of 1951.

A.N.Z.A.A.S. Meeting in Brisbane: Overseas Scientists

The Executive Committee recommended that invitations be issued to six scientists:

- The President of the Royal Society;
- The President of the British Association for the Advancement of Science;
- The President of the Royal Society of Canada;
- The President of the South African Association for the Advancement of Science;
- The President of the Indian Science Congress;
- and to a distinguished social scientist in Great Britain.

Commonwealth Grants to Non-University Institutions

The Chief Executive Officer of C.S.I.R.O. reported that the Scientific and Industrial Endowment Fund was employed for two purposes: viz., for persons engaged in scientific research, and for the training of students in scientific research. Those who benefited from the former were usually scientists who were working alone and no worth-while worker had been refused. There was an accumulated credit in the fund.

Executive Meeting, February, 1951

Dr. J. L. Pawsey was appointed to act as radio-astronomer on the Australian National Committee on Astronomy.

The following were appointed as delegates to the General Assembly of the International Union of Geodesy and Geophysics, to be held in Brussels in August 1951:

C. H. B. Priestley, R. v. d. R. Woolley, J. M. Rayner, E. G. Bowen, A. D. Ross.

Obituary

A. E. V. Richardson

THE death occurred in Melbourne, in December 1949, of Dr. A. E. V. Richardson, C.M.G., a few months after his retirement from his position of Chief Executive Officer of the Council for Scientific and Industrial Research.

Richardson was born in Adelaide in 1883. Early in his education he received the bent towards the service of the agricultural and pastoral industries which was to become his life's work. He attended the first school in South Australia which was the equivalent of a High School; it was known as the Agricultural School and had many associations with the School of Mines. From this school he went to Roseworthy Agricultural College. Shortly after completing the College diploma dourse with distinction, he continued his studies at the University of Adelaide, where he graduated B.A. in 1907, B.Sc. in 1908, and M.A. in 1910.

This academic discipline, together with his capacity for solid work and attention to detail, provided Richardson with a firm foundation for the scientific and administrative work which he was subsequently to undertake.

His first agricultural appointment was to the position of Assistant Director of Agriculture in South Australia in 1908. For some time before he was appointed Superintendent of Agriculture in Victoria, in 1911, he was Acting-Director in South Australia. In the three years in the South Australian service he established a high reputation for the large amount of experimental work which he initiated, particularly in connexion with the problems associated with the wheat industry. While resident at the Parafield experimental farm he initiated a programme of selection and breeding in wheat, and it was from one of his crosses made at Parafield that the well-known high-yielding variety 'Gallipoli' was eventually selected. In this period he conducted experimental plots on both governmental and private farms, mainly in connexion with testing of fertilizers and wheat varieties, establishing in many ways the pattern which he was to use in Victoria at Rutherglen, Werribee and Longerenong with far greater resources.

In 1918 he visited the United States and Canada and submitted a report to the Victorian Government on education in agricultural science. The School of Agriculture of Melbourne University on its present basis was the outcome of this report and he became the first Dean and Director of the School in addition to maintaining his work for the Victorian Department. It was in this period that he received the D.Sc. of Melbourne University for his research work in agriculture.

In 1925, with the establishment of the Waite Agricultural Research Institute by the University of Adelaide, Richardson returned to South Australia as first Director of the Institute and Waite Professor of Agriculture. He laid the pattern for the subsequent development of the Institute which was to make it a leading centre for agricultural research. In this new appointment he found time personally to carry forward many scientific investigations which he had pioneered in Victoria. An important factor in determining Richardson's decision to return to Adelaide was the guarantee of support to the University by the Government of South Australia for the work of the Institute.

In 1926 the Council for Scientific and Industrial Research was established and in 1927 Richardson accepted the invitation to become a member of the executive committee of that body. In 1938 he left the Waite Institute to take up full-time work with the Council as Deputy Chief Executive Officer; he became Chief Executive Officer in 1946 on the retirement of Sir David Rivett.

During 1926 Richardson visited Europe and re-visited the United States, paying special attention to the organization of agricultural research. In 1927 he was a delegate to the first Imperial Agricultural Research Conference in London, and in 1932 he was an official adviser to the Australian Delegation at the Ottawa Conference. He was a member of the Agricultural Settlement Committee of South Australia in 1931. He was created C.M.G. in 1932. He was a founder of the Australian Institute of Agricultural Science and, as the recognized leader of Australian agricultural science, he became the first President of the Institute in 1935. In 1947 he was President of the Australian and New Zealand Association for the Advancement of Science.

With all his heavy administrative responsibility, Richardson found time to carry out much basal research on the field or agronomic problems concerned with wheat growing. Early in his Victorian experience he prepared a bulletin on 'Wheat and Its Cultivation', and this was revised during 1924 on the basis of a decade of work on the subject, to become the standard Australian text. This work was rounded off by a series of investigations at the Waite Institute on the value of nitrogenous fertilizers for stubble-sown cereal crops. Richardson was concerned also in the early application to pastures of the methods he had used in the study of crops, and an important contribution was his study of the yield of an irrigated permanent pasture under various systems of management at Woods Point; a quantitative study which continues to yield valuable data for illustrating certain basal principles. His most sustained individual investigation was the study of the water requirement of farm crops, beginning at Werribee in 1914 and con-

tinuing with improved facilities at Rutherglen until 1923. At the Waite Institute the work was resumed in 1925 and extended to the study of pasture plants. These investigations followed the classical lines of the determination of transpiration ratios and were continued until 1931. They established techniques in pot experiments and formed a valuable source of data for the climatological studies which have since been a characteristic feature of the work of the Waite Institute.

Richardson thus played a very important part in the development of agricultural education and research in Australia during an important formative period in its scientific history. He is survived by his wife and daughter.

J. A. Prescott.

Research Notes

Partial Denervation of Muscle, and Its Consequences*

It has long been known that if the nerve-supply of a muscle is completely severed there is an immediate and complete paralysis of the muscle, followed after some delay by partial degeneration of some of its fibres; and that recovery takes place slowly, and often incompletely, by the downgrowth of regenerating nerve-fibres from the surviving stump, along the degenerated nerve.

For some time there have been indications that this is not the whole story; thus, as early as 1885, Exner found that severing part of the nerve-supply of the muscle apparently produced no degeneration, while more recently three groups of workers found that, following partial denervation, muscles recovered their function more rapidly than could be explained on the classical theories of nervous regeneration. The significance of these observations has been revealed by the recent observations of Edds, in Providence (U.S.A.), and Hoffman, working in Melbourne. If the muscle is partially denervated, then within three days surviving nerve fibres within the muscle form sprouts, which grow out and penetrate the fibrous sheaths of the degenerated nerve fibres, then run down them and re-innervate the muscle fibres which have been deprived of their innervation. Surviving motor end-plates also sprout 'ultraterminal' processes which grow out and re-innervate denervated muscle fibres, forming new end-plates at the sites of the degenerated ones. In this way the muscle is effectively re-innervated within a few weeks.

The mechanism underlying this regenerative process is not yet entirely clear, but it appears that the diffusion of a lipid substance from the degenerating nerve fibres stimulates surviving ones to sprout. The mechanism by which the sprouts are oriented is also obscure, since ether extracts of nervous tissues, injected into normal muscles, will cause sprouting of nerve fibres and end-plates, but the orientation of these sprouts is random, in contrast to the behaviour of sprouts obtained by partial denervation of the muscle.

It is now of interest to consider the fate of the severed nerve fibres, regenerating into the muscle which has already been re-innervated in the abovementioned manner. It appears, according to some recent experiments by Hoffman, that these fibres regenerate down their old pathways until they reach the re-innervated muscle fibres, when they connect up with the new end-plates, resulting in doubly innervated end-plates, and other abnormal structures.

These observations may have relevance in regard to the problem of recovery following poliomyelitis. We should expect that some degree of re-innervation from sprouting of surviving nerve fibres would occur, and histological examination should be directed towards detecting this process. A more precise chemical identification of the substance causing sprouting of nerve fibres might provide a means of accelerating the normally-occurring process.

* Report by H. Hoffman, Department of Zoology, University of Melbourne.

Mosquito-Borne Myxomatosis*

Myxomatosis, the virus disease of rabbits that has been under test by the C.S.I.R.O., has lately become widely established along the Murray River and some of its tributaries. Mosquitoes are undoubtedly responsible for this development. These insects are known to spread myxomatosis among domestic rabbits in America, and some years ago the C.S.I.R.O. Division of Animal Health and Production demonstrated that the disease could be transmitted from sick to healthy rabbits by several Australian mosquitoes, including two species that were biting in the Murray Valley and the Riverina during the early summer months.

The recent widespread distribution of the disease indicates an altogether unsuspected mobility in the mosquito population. No doubt winds assisted the longest hops, but the mosquitoes themselves must have flown over very great distances. It is believed that the first, and most important, 'jump' made by the disease was from the test site near Balldale to the common lands outside Corowa, some 13 miles to the south-east, and that this occurred early in December. From this point on the Murray River myxomatosis has spread, and is still spreading, up and down stream on both the northern and southern banks. By January it was known to have reached and passed Howlong

* Report by F. N. Ratcliffe and B. V. Fennessy, Wild Life Section, C.S.I.R.O., 29 January 1951.

to the east and to extend 20 miles or more downstream of Corowa.

There was one other well-established and very active centre of infection on the Murray, some 80 miles west of Corowa. This was the Barmah-Mathoura area. Between this point and Corowa there were two records of occurrence. To the north of the Murray, myxomatosis was active at Hillston, on the Lachlan River and has been recorded from Condobolin. The report of the Hillston occurrence stimulated a survey of the Murrumbidgee River, and an outbreak of the disease was located at Darlington Point, on the direct line between Corowa and Hillston (which are 180 miles apart).

Wherever the situation has been carefully examined, the picture seems to be substantially the same. The disease tends to be confined to the river flats and frontage country, and one or two hundred yards may often see the difference between high and very low levels of infection in the rabbit population. In the Corowa-Rutherglen area, where the most detailed observations have been carried out to date, there was a very obvious and clear relation between the activity of the disease and the proximity of weedy lagoons. These are the breeding places of the dusk-biting *Culex annulirostris*, which was the only species of mosquito active and abundant in the district at the time.

On the Victorian side of the river, west of Rutherglen, odd cases of myxomatosis have occurred in paddocks up to two or three miles from the banks (and an even greater penetration 'inland' in parts of the Mathoura outbreak area). The fate of the disease in such places will depend primarily on what happens on the mosquito 'front', *for without the assistance of these insects the spread of the infection would almost certainly be negligible.*

There have been two or three reports of isolated occurrences of the disease well away from the river, which apparently petered out. These were probably the reflection of mosquito activity that has since died away. Large numbers of day-biting mosquitoes (species of the genus *Aedes*) afflicted the Corowa-Rutherglen area until Christmas time. They were widely distributed over the open country and were almost certainly responsible for 'picking up' the virus of myxomatosis from the Balldale test site and carrying it to the river. They were also probably responsible for giving the disease a flying start in the Corowa common area, and for its long-range dispersal from that centre. After their rather sudden disappearance (in the Corowa area, at any rate) the task of transmitting myxomatosis seems to have been left to the night-biting *Culex* mentioned above.

Assessment of Value

When attempting to draw conclusions from the present myxomatosis situation, it is important to view it in proper perspective and to appreciate that the picture is dynamic and developing. Thus it is ridiculous, on the one hand, to hail the disease as a general solution of the rabbit problem: on the other hand it would be a mistake to assume that in paddocks where the infection is established, but showing no sign as yet of causing an effective mortality, it will not ultimately succeed in doing a useful job. A great deal will be learned from observations in the very near future.

A few weeks will undoubtedly reveal a considerable extension of the disease along the Murray and its tributaries, and it is not impossible that before the end of the summer its distribution will be virtually continuous. In myxomatosis we can now see a useful weapon for dealing with rabbits on certain types of river frontage country, where the problem of their control has hitherto proved almost insuperable.

One question that cannot yet be answered is whether the disease will manage to hang on over the winter in some spots along the creeks and rivers. If it does—which is not impossible, nor even perhaps unlikely—it will undoubtedly take advantage of the spring mosquito emergence, and some very interesting developments can be expected.

The myxomatosis epidemic has reached such proportions that it is beyond the powers of C.S.I.R.O. officers to cover it both generally and in detail. Special attention will therefore be given to studying the progress of the disease at selected points showing a variety of conditions; and an attempt will be made to visit and check up on any outbreak of special interest.

The most valuable assistance that could be rendered by interested observers would be reports giving details of the sort that investigators would seek on the spot: that is, the date of the first appearance of the disease; the type of country in which it is working (nature of pasture and tree cover, if any, and distribution of the surface waters); some indication of mosquito abundance and activity; and finally, and most important, an estimate of the progress of the disease over a period of time.

Perhaps the best way of assessing the progress of the disease, if any, in any given spot is to make counts of the number of sick rabbits seen on a standard 'round' carried out at weekly intervals at the same time of day. If only easily recognizable cases are counted, an entirely new 'crop' will have developed by each inspection, for the sick rabbits seen the week before will be dead. Reports can be sent to the Pasture Protection Boards in New South Wales, or officers of the Lands Department of Victoria, who are co-operating in the myxomatosis tests, or addressed to the Officer-in-Charge, Wild Life Section, C.S.I.R.O., P.O. Box 109, Canberra.

Symptoms

The symptoms of myxomatosis (swollen head, 'bunged up' and discharging eyes, general 'dopeyness') render the disease unmistakeable in the advanced stages. The general symptoms begin to appear on the seventh or eighth day after infection, and death usually ensues by the twelfth or thirteenth day at the latest.

It is perhaps advisable to emphasize that any fears that the infection may be spread to human beings, stock and dogs, are quite unfounded. The safety of the virus was established by extensive tests before permission was granted by the health authorities for experiments with it in the field.

(The following note continues the account given in the contributed report printed above.)

A conference of a committee of experts and governmental officers was convened in Melbourne on 15 February to review developments. From the presumed original appearance in the Corowa-Rutherglen area the dispersal of the disease had been mainly north and west; outbreaks had been reported along all main tributaries of the Murray in New South Wales, from Broken Hill in the west to the Queensland border in the north and the Carinda-Forbes districts in the east. The spread in Victoria had been relatively slight in proportion, but officers of the Department of Lands had been instrumental in introducing the disease in various centres in the State. Outbreaks had occurred in one or two places in South Australia.

In all those areas in which detailed inspections had been carried out the findings were substantially the same. Active transmission and high mortalities had been confined to relatively narrow stretches along the water frontages and to swampy areas where mosquitoes are, or had recently been, prevalent. In some of the old outbreak areas the epidemic showed signs of slowing down, with virtual extermination being achieved in the more favourable spots and little progress being observable elsewhere.

Sir Macfarlane Burnet, of the Walter and Eliza Hall Institute, and Professor Fenner, of the National University, have undertaken to collaborate in the investigation of variations of the strain and virulence of the virus in the field. The possibility exists that some proportion of the animals infected will recover from the disease and a resistant population be built up. As better understanding of the distribution and behaviour of mosquitoes is most obviously required, the entomological aspects of the investigation will be intensified.

It is not practicable, at this late stage in the season, to organize a general distribution of the virus. The New South Wales Department of Agriculture and the Victorian Department of Lands, however, will assist the spread of the disease by introducing it into new areas where it is unlikely to spread naturally before the winter, and landholders will no doubt continue to disseminate the infection by collecting sick rabbits and liberating them on their properties.

The committee will meet again during the winter, and with the information then available will formulate a programme for the comprehensive use of myxomatosis in the following spring and summer. It is expected that States other than New South Wales and Victoria concerned in the present investigations will be interested in future plans.

News

Royal Society Medallists

His Majesty the King has been graciously pleased to approve recommendations made by the Council of the Royal Society for the award of the two Royal Medals for 1950 as follows:

To Sir Edward Appleton, G.B.E., K.C.B., F.R.S., for his work on the transmission of electromagnetic waves round the earth and for his investigations of the ionic state of the upper atmosphere.

To C. F. A. Pantin, F.R.S., for his contributions to the comparative physiology of the Invertebrata, particularly his work on nerve conduction in Crustacea and Actinozoa.

The following awards of Medals have been made by the President and the Council of the Royal Society:

The Copley Medal to Sir James Chadwick, F.R.S., for his outstanding work in nuclear physics and the development of atomic energy, especially for his discovery of the neutron.

The Rumford Medal to Air Commodore Sir Frank Whittle, K.B.E., C.B., F.R.S., for his pioneering contributions to the jet propulsion of aircraft.

The Davy Medal to Sir John Simonsen, F.R.S., for his distinguished researches on the constitution of natural products, especially the plant hydrocarbons and their derivatives.

The Darwin Medal to Professor F. E. Fritsch, F.R.S., for his distinguished contributions to the study of algology.

The Hughes Medal to Professor M. Born, F.R.S., for his contributions to theoretical physics in general and to the development of quantum mechanics in particular.

British Science Centre

Long-term proposals originated by the Royal Society for a British Science Centre in London have been adopted by the Government of the United Kingdom. It will be some years yet before the Minister of Works can build such a Centre, but a start will be made as soon as resources can be found, having regard to other urgent claims.

Within the Science Centre accommodation will be built for the Royal Society and for a number of other scientific societies with their special libraries. Most of these are now severely cramped in rooms which were provided for them by the Government about a hundred years ago in Burlington House or in other inadequate accommodation. The Centre will also include the Patent Office and its library, which will be modernized and extended as a first-rate reference library on science and technology. There will also be new offices for the Department of Scientific and Industrial Research and other government scientific organizations. The centre will be designed to improve facilities and contacts between scientists and the users of science, both nationally and internationally. The selection of a site is expected early in 1951. Much detailed planning remains to be done before the final scheme can be developed.

Nichols Fellowship

The Council of the Royal Society of Medicine invites applications for a grant of £225 per annum in aid of research to be carried out to advance knowledge in obstetrics and gynaecology, which will be awarded on the recommendation of the Council of the Section of Obstetrics and Gynaecology of the Society.

The place at which the work is to be carried out and an outline of the proposed research must be stated in the application. A preliminary report on the progress of the research must be submitted at the expiration of the first six months. The Fellowship will be awarded in the first place for a period of one year and, at the discretion of the Council, may be extended for a second year. Applications must be received by the Secretary, Royal Society of Medicine, 1 Wimpole Street, London, W.1., by 31 March 1951.

World Petroleum Congress

The Third World Petroleum Congress will be held at Scheveningen, the seaside resort of The Hague, from 28 May to 6 June 1951. The objects of the Congress are:

To focus attention on the present status of science and technique in the petroleum industry;

To further the study of the science and technology of the petroleum and allied industries on an international scale;

To initiate discussions on all or any of the problems confronting the oil industry;

To provide facilities for those connected with the scientific and technical developments of oil and allied subjects to exchange knowledge and information freely;

To give opportunities for making personal contacts with scientists, technicians and technologists of many countries;

To show the consumers of oil products that the oil industry provides the best products that science and technique can create.

The first Congress was held in London in 1933 and the second in Paris in 1937. The third Congress is being organized by the Petroleum Engineering Section of the Koninklijk Nederlands Instituut van Ingenieurs.

The programme of the Congress, in addition to the usual plenary sessions, sectional meetings, lectures and official receptions, includes both industrial and tourist excursions, an International Cabaret (optional) and a concert by The Hague Philharmonic Orchestra.

The sections are: Geology and Geophysics; Drilling and Production; Physical operations in oil processing; Oil processes involving chemical conversions; Production of chemicals from petroleum, their properties and applications; Measurement and control, analysis and testing, composition of petroleum; Utilization of oil products; Construction of equipment, materials, corrosion; Transport, storage and distribution; Economics and statistics, documentation, education and training. Papers at sectional meetings will not be read but will be introduced by a short summary, particularly of points which will stimulate discussion.

Application forms for membership of the Congress, and other particulars, may be obtained from the Australian Committee for the Congress, c/- The Royal Australian Chemical Institute, 55 Collins Place, Melbourne.

Rabbit Research

The C.S.I.R.O.'s plans for rabbit research have been released in a short brochure, *The Rabbit Problem—A Survey of Research Needs and Possibilities*. The report emphasizes the difficulty of finding an easy and universally applicable solution to the rabbit problem, and the importance of making the most effective use of existing control methods. A survey of research possibilities in the light of present knowledge shows no line of investigation that seems likely to lead to any revolutionary innbvation in methods of rabbit control (other than the use of myxomatosis, which will benefit certain areas only).

In view of the widespread occurrence of the rabbit in Australia it is astonishing how little factual information is available on its habits. It is only through an accurate knowledge of the biology of the rabbit that control methods can

be improved significantly. A start has therefore been made on a comprehensive biological study of the rabbit which it is expected will uncover new possibilities for control. At the same time, several improvements to existing control techniques are being investigated. For example, there seems hope of improving the efficiency of fumigation and there is a fair prospect of bringing about an over-all and probably major increase in the efficiency of poisoning.

The report concludes with a suggestion for a small-scale experiment in 'district control' which might be conducted under the auspices of State or local authorities. This would be carried out in the zone of better-class pastoral country where the rabbit affects Australia's production and economy most. The real need in this region is not for methods of dealing with plague (or even particularly dense) rabbit populations, but for ways and means of bridging the gap between partial control and eradication. This experiment would determine what was involved in, and what could be achieved by, an organized campaign having as its object the complete eradication of rabbits from selected areas.

Conference on Subjective Judgments

The use of man as a meter to measure his surroundings was the subject of a Conference on Subjective Judgments held at University College, London, on 14 October 1950. Nearly 200 physicists, engineers and psychologists discussed experimental techniques using the taste, touch, sight, smell and hearing of human 'subjects'. The conference divided itself into two opposing points of view—the 'can'ts', who maintained that measurement of sensations was not possible and pointed out fallacies in experimental methods, and the 'musts', who insisted that however philosophically unsound their techniques might be considered to be in the light of existing knowledge, they served their purpose if they gave data of precise operational value.

It is believed that the conference is the first of its kind ever to have been held; it was arranged as a private venture largely as the result of the initiative of R. G. Hopkinson (Building Research Station, D.S.I.R.). It was designed to bring together workers from different fields who do not normally meet but who are concerned with subjective judgments. The proceedings of the conference will not be published. The main speakers have papers describing their techniques which may be available on request.

The morning session produced a clash of opinions on the problem of the relationship between the physical stimulus (e.g., luminance) and the resulting sensation (e.g., brightness). D. B. Fry (University College, London) maintained that sensations could be measured in some numerical fashion. W. D. Wright (Imperial College, London) asserted that sensations could not, on first principles, be measured since there was no means of putting any yardstick alongside them. R. W. Pickford (University of Glasgow) suggested that, even if sensations could not be measured, it was often possible to carry on usefully as if they could. He counted himself among the 'as ifs'. The conference was divided into those who wished for the perfect experiment, even if it would take fifty years to obtain an answer, and those who had to obtain an answer at once. If the techniques used gave answers which were demonstrably right then the fact that the methods were unproved was not of first importance.

The afternoon session was devoted to consideration of the usefulness of the human being as an assessor of his surroundings. Opinions were divided on much the same lines as the morning. Techniques used for subjective judgments were described by a number of workers. D. Richards (Post Office Engineering Research Station) gave examples in acoustics, where men and women were used to show the degree of distortion in telephones. R. G. Hopkinson gave examples of the likes and dislikes of occupants of rooms constructed by modern techniques which lead to high heat insulation but low thermal capacity, and of the effects of glare in rooms with large modern windows. Tactile studies were mentioned by R. Harper (University of Leeds) when speaking of cheese testing at the National Institute of Research in Dairying, Reading. He described the 'fight back' of Cheshire cheese.

A topic which raised much discussion was the use of 'trained observers', who are intelligent people capable of understanding the nature of the observations required of them. Such observers can give assessments readily and can report their readings with reliability. Their observations can be shown to agree at selected points with those of a random selection of the general public. Many speakers thought that this was a dangerous theory; that the observers were trained to give the required answers. E. C. Bate Smith and E. H. Callow (Low Temperature Research Station, D.S.I.R.) said that they had found a check between the findings of their taste panels of trained observers and the price paid for meat by the consumer.

Other examples of subjective studies were given by L. T. Wilkins (Social Survey who pointed out that the nature of an interview with a subject had an effect on the results. For instance, if a housewife were being interviewed alone she would put forward a number of grumbles. If she were interviewed in her husband's presence she would put forward many more grumbles even if her husband remained quite silent. On the other hand the presence of her children had no effect whatsoever.

R. L. Moore (Road Research Laboratory, D.S.I.R.) put forward the suggestion that so far as possible the experiments should be designed so that the subject would automatically give a reaction, which could be interpreted by the experimenter rather than leaving the interpretation to the subject. He gave as examples his work on 'buses, where the degree of deceleration was judged by the effect on the passengers.

The conference roused greater interest than had been anticipated and it appears that the time is ripe for the techniques of subjective studies to be codified. The drive to do this will have to come from the 'as ifs' and the 'musts', but physicists and psychologists can help with information about measuring instruments which should, in due course, lead to increasing speed and efficiency in the practice of subjective assessment.

National University

The Chair of Geography, in the Research School of Pacific Studies, has been filled by the appointment of O. H. K. Spate, the Reader in Geography in the London School of Economics and Political Science. Previously the only Chair in Geography in Australia had been that at the University of Sydney. Professor Spate, who is thirty-nine years of age, was five years lecturer in the university at Rangoon and spent his war service chiefly in Burma, together with some time in India, Pakistan and Ceylon. His main interests have been in the regional and political geography of monsoon Asia; he received the Gill Memorial Award of the Royal Geographical Society in 1947. He is co-editor of *The Changing Map of Asia: A Political Geography*, which is shortly to be published. He expects to take up residence at the University in June.

It is planned that by 1952 three of the four research schools—those of Physical Sciences, Social Sciences and Pacific Studies—will be active in Canberra, while the John Curtin School of Medical Research will continue its work in other centres for several more years until the medical laboratory has been completed. From the beginning of 1952 the University hopes to be able to admit to each school a number of research students. The intention is that these students will normally have completed, in Australia or elsewhere, a Master's degree or its equivalent. They will be able, on presentation of satisfactory evidence of standing, to proceed to the Ph.D. degree of the University by a course of supervised research on an approved topic. The course will normally occupy three years of full-time work, and will call for residence in Canberra or (where departments are working out of Canberra) elsewhere. It may be possible to make limited arrangements for the reception of students with good qualifications to work otherwise than for a degree.

No general invitation was extended to students to enrol at the beginning of 1951, but the heads of some of the departments were able to accept one or two nominated students. All students are required to pay fees, though they may be remitted in special circumstances. For the time being, until University House is completed, they must find their own accommodation in Canberra. A limited number of scholarships have been made available to students, tenable for periods up to three years. Where facilities cannot be offered within the schools at Canberra, arrangements may be made for the award to be tenable at another university in Australia or overseas.

The University also offers a small number of scholarships to Australian graduates of Master's or equivalent standing, who wish to gain research training in fields other than those in which the research schools are directly interested. Tenure will be two years only. These awards will normally be held abroad, at an institution approved by the University.

Applications have been invited for appointment to Research Fellowships and Senior Research Fellowships in the Research School of Physical Sciences. The salary range for Research Fellows is £750-£950 per annum. That for Senior Research Fellows is under review, but the commencing salary will be not less than £1200 per annum. A cost-of-living adjustment, at present £90 per annum, is payable in each case. The tenure of each grade of Research Fellow is three years, renewable to five years. Research Fellows may in due course be promoted to Senior Research Fellowships, and any Research Fellow may be appointed to a post on the permanent staff of the school. Superannuation provision will be made in accordance with the University's scheme. Research Fellows must be graduates with honours in experimental physics, theoretical physics, mathematics or radio-chemistry and must have had at least two years' experience in research in nuclear physics, cosmic rays, geophysics or radiochemistry. Further experience will be expected of applicants for Senior Research Fellowships.

University of Queensland

Dr. T. K. Ewer has been appointed to the Chair of Animal Husbandry. He came to Australia from England at the age of seventeen, and won a scholarship to the Hawkesbury Agricultural College. After graduating B.V.Sc. from the University of Sydney in 1937, he accepted a position in the Department of Agriculture in New Zealand, where he was in charge of the Kirwee Experimental Farm from 1940 to 1946. Much of the research at the farm was upon the feeding of sheep under local conditions, and upon nematode infestation. In 1946 he was appointed senior lecturer in veterinary science at Canterbury Agricultural

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

February, 1951.

EDITOR: STEPHEN J. COPLAND, c.o. Linnean Society of N.S.W., Science House, 157 Gloucester Street, Sydney.

Vol. 28 **No. 5**

BOTANY.

Hon. Abstractor: J. W. Vickery.

15624. **Seaton, J. S.** Establishment of *Verticordia grandis* and Other Native Plants. *Vict. Nat.*, lxvi (11), 1950, 216.

15625. **Vickery, Joyce W.** The Species of *Amphipogon* R.Br. (Gramineæ). *Contrib. N.S.W. Nat. Herb.*, i (5), 1950, 281–295.—The genus is endemic to Australia, occurring in all States except Tasmania, and is represented by seven species. The present paper is a systematic revision of the genus, and a key is provided for identification of the species. One new combination, *A. amphipogonoides* (Steud.) is made, and four new varieties are described.

15626. **Vickery, Joyce W.** New Species of *Danthonia* D.C. (Gramineæ) from Australia. *Contrib. N.S.W. Nat. Herb.*, i (5), 1950, 296–301.—Formal descriptions are given of *D. acerosa*, *D. alpicola* *D. Clelandii*. *D. frigida*, *D. induta*, *D. lævis*, *D. monticola*, *D. nivicola*, *D. occidentalis*, *D. purpurascens* and *D. Linkii* var. *fulva*.

15627. **White, C. T.** The Genus *Embothrium* Forst. (Family Proteaceæ) in Australia. *Proc. Roy. Soc. Qld.*, lx (4), 1949, 43–44.—*E. pinnatum* stat. nov. is established in specific rank, based on *E. Wickhamii* var. *pinnatum* Maid. and Betche. This is a native of N.S.W. and south-east Queensland, while *E. Wickhamii* occurs in north-east Queensland. The trees are described and their differences summarized.

15628. **Willis, J. H.** The Chequered Story of Two Tasmanian Mosses. *Vict. Nat.*, lxvii (2), 1950, 30–35.—The nomenclatural history of *Tayloria Gunnii* (W. Wilson in Hook.) Willis n. comb., and *T. tasmanica* (Hampe) Brotherus, together with a discussion on their morphology, habitat and systematic position.

15629. **Willis, J. H.** New Record for Rare Victorian Clubmoss. *Vict. Nat.*, lxvii (2), 1950, 19.—*Lycopodium scariosum* is recorded from Bogong High Plains, representing the third occasion of its collection.

ZOOLOGY.

Hon. Abstractor: A Musgrave.

15630. **Allan, Joyce.** Land Shells of Australia. Part I. *Aust. Mus. Mag.*, x (2), March 31 (=4 July, 1950), 50–54, illustr.—Popular account of the more unique Australian land shells—typical arboreal and terrestrial forms, mostly from the coastal belt of northern and eastern Australia.

15631. **Allan, Joyce.** Fauna. Mollusca. *Australian Fisheries*, 1950, pp. 37–41.

15632. **Allen, F. E.** Investigations on Underwater Fouling. III. Note on the Fouling Organisms attached to Naval Mines in North Queensland Waters. *Aust. J. Marine and Freshwater Res.*, Melbourne, i (1), April, 1950, 106–109, pl. 1.—The most important groups of organisms represented were the mollusca, corals, serpulids, bryozoa and algæ. The commonest forms on all the mines were the molluscs, *Chama* sp.

15633. **Allen, F. E., and Wood, E. J. Ferguson.** Investigations on Underwater Fouling. II. The Biology of Fouling in Australia: Results of a Year's Research. *Aust. J. Marine and Freshwater Res.*, Melbourne, i (1), April, 1950, 92–105, pls. 1–3, tfs. 1–5.— Outlines the first year of work with some preliminary conclusions. Lists the more abundant fouling organisms and their seasonal abundance from a study of glass plates exposed to fouling in the sea in south-east of Australia.

15634. **Bearup, A. J., and Bolliger, A.** Trichostrongylus Infections in the Common Phalanger (*Trichosurus vulpecula*). *Aust. J. Sci.*, xii (2), 21 Oct., 1949 (received 18 April, 1950), 75–76.—*Trichostrongylus colubriformis* and *T. rugatus* worms, which are important parasites of sheep, here recorded from the intestine of a Common Possum (Phalanger) which had died from diarrhoea. These worms were also found in the fæces of other possums not suffering from the complaint.

15635. **Blackburn, M.** Age, Rate of Growth, and General Life-history of the Australian Pilchard (*Sardinops neopilchardus*) in New South Wales

Waters. *Bull. C.S.I.R.O.*, Australia, Melbourne, No. 242, 1949, 1–86, pls. 1–8, tfs. 1–8.

15636. **Blackburn, M.** Fishery Management and Changes in Abundance of Fish. *Aust. J. Sci.*, xii (1), Aug. (=Dec.), 1949, 14–17.

15637. **Blackburn, M.** A Biological Study of the Anchovy, *Engraulis australis* (White), in Australian Waters. *Aust. J. Marine and Freshwater Res.*, Melbourne, i (1), April, 1950, 3–84, pls. 1–5.—Three subspecies are recognized by their mean vertebra numbers, in combination with the region of occurrence. *E. a. australis* (White) in Q'land to all but the southernmost waters of N.S.W.; *E. a. antipodum* Gunther from the border region of N.S.W. through Victorian, Tasmaniam and S. Australian waters; *E. a. fraseri* n. subsp. in W.A. Each subspecies is further divided into local populations which intergrade.

15638. **Blackburn, M.** The Condition of the Fishery for Barracouta, *Thyrsites atun* (Euphrasen), in Australian Waters. *Aust. J. Marine and Freshwater Res.*, Melbourne, i (1), April, 1950, 110–128, pls. 1–2, tf. 1–4.—Gives notes on the distribution of the species and discusses its economic importance as a food fish.

15639. **Blackburn, M., et alia.** Chief Fisheries. *Australian Fisheries.* (A handbook prepared for the Second Meeting of the Indo-Pacific Council, Sydney, April, 1950), pp. 56–71.—This chapter is contributed by some ten members of the C.S.I.R.O., Fisheries Division, gives details of the distribution and biology of certain important commercial fishes studied in the research programme of the Commonwealth Scientific and Industrial Research Organization.

15640. **Blackburn, M., and Tubb, J. A.** Measures of Abundance of Certain Pelagic Fish in Some South-Eastern Australian Waters. *Bull. C.S.I.R.O.*, Australia, Melbourne, No. 251, 1950, 1–71, tfs. 1–3, pls. 1–2.—*See also* Sheard, K., pp. 72–74.

15641. **Boardman, W.** The Hair Tracts in Marsupials. Part III. Description of Species, concluded. *Proc. Linn. Soc. N.S.W.*, 1949, lxxiv (3–4), 21 Oct., 1949, 192–195, 2 tfs.

15642. **Boardman, W.** The Hair Tracts in Marsupials. Part IV. Direction Characteristics of Whorls and Meristic Repetition of Radial Fields. *Proc. Linn. Soc. N.S.W.*, lxxv (1–2), June 7, 1950, 89–95, tf. 1.

15643. **Boschema, H.** Notes on Specimens of the Genus *Millepora* in the Collection of the British Museum. *Proc. Zool. Soc. Lond.*, cxix (3), Nov., 1949, 661–672, pls. i–ii.—Mentions, *inter alia*, coral material from Australian seas collected by W. Saville-Kent.

15644. **Bourke, P. A.** The Breeding Population of a Thirty-five Acre "Timber Paddock". *Emu*, xlix (2), Oct., 1949, 73–83, pls. 8–10.—Lists the birds breeding in a particular area in the Cowra district, N.S.W., during spring and summer of 1947 and 1948, and gives notes on some species.

15645. **Carlgren, O.** Corallimorpharia, Actiniaria and Zoantharia from New South Wales and South Queensland. *Ark. f. Zool.*, (A.S.), i (2), 13 April, 1950, Nr. 10, 131–146, pls. i–iii, 16 tfs.

15646. **Chabanaud, P.** Description de quatre espèces inédites de genre *Symphurus*. *Bull. Mus. Nat. d'Hist. Nat.*, Paris, (2) xx (6), 1948, 508–511.—*S. holothuriæ* sp.n. N.W. Aust.: Holothuria Bank.

15647. **Cleland, J. B.** The Archibald Watson Memorial Lecture. The Naturalist in Medicine, with Particular Reference to Australia. *Med. J. Austr.*, i, 37th year, No. 17, April 29, 1950, 549–563, tfs. 1–5.

15648. **Copland, S. J.** Nomenclature and Type Specimens of Two Species of Sphenomorphus (Sauria: Scincidæ). *Copeia*, 1950, No. 1 (March 30), 57.—Refers to paper in *Proc. Linn. Soc. N.S.W.*, 1946, vol. 70.

15649. **Cotton, B. C.** Mollusca from Western Australia. *Rec. S. Austr. Mus.*, ix (3), June 30, 1950, 333–338.

15650. **Deignan, H. G., and Amos, B.** Notes on Some Forms of the Genus *Chalcites* Lesson. *Emu*, xlix (3), Jan., 1950, 167–168.—Refers to *C. malayanus minutillus* (Gould), recorded from islands in the Banda Sea and from the Northern Territory, Australia.

15651. **Farran, G. P.** The Seasonal and Vertical Distribution of the Copepoda. *B.M. (N.H.) Great Barrier Reef Exp.*, 1928–29, *Sci. Rpts.*, ii (9), 22 Jan., 1949, 291–312, tfs. 1–17.

15652. **Fleay, D.** The Peculiar Little Numbat. *Animal Kingdom*, New York, lii (5), Sept.-Oct., 1949, 144–148, illustr.—A popular account of the Banded Ant-eater, *Myrmecobius fasciatus*, of Western Australia.

15653. **Fleay, D.** Goannas. Giant Lizards of the Australian Bush. *Animal Kingdom*, New York, liii (3), June 5, 1950, 92–96, illustr.—Perentie, *Varanus giganteus*; Tree-climbing Goanna, *V. varius*; Sand Goanna, *V. gouldi*.

15654. **Fleming, C. A.** Some South Pacific Sea-bird Logs. *Emu*, xlix (3), Jan., 1950, 169–188, tfs. 1–8.

15655. **Fraser-Brunner, A.** On the Fishes of the Genus *Euthynnus*. *Ann. Mag. Nat. Hist.*, (12) ii (20), Aug. (7 Oct.), 1949, 622–627, tfs. 1–2.—Key to the species and subspecies of this genus; records *E. affinis affinis* (Cantor) from Australia.

15656. **Fraser-Brunner, A.** A Synopsis of the Hammerhead Sharks (*Sphyrna*), with Descriptions of a New Species. *Rec. Aust. Mus.*, xxii (3), Jan. 27, 1950, 213–219, tfs. 1–3.—*S. ligo* sp.n. N.S.W.: Clarence River. Key to spp.

15657. **Fraser-Brunner, A.** The Fishes of the Family Scombridæ. *Ann. Mag. Nat. Hist.*, (12) iii (26), Feb., 1950, 131–163, tfs. 1–35.

15658. **Gentilli, J.** Foundations of Australian Bird Geography. *Emu*, xlix (2), Oct., 1949, 85–129, 14 maps.

15659. **Gentilli, J.** Pallid Cuckoo Observations, 1949. *W. Aust. Nat.*, ii (3), Jan., 1950, 59–64.—*Cuculus pallidus* is here used as a pointer to weather conditions in south-western Australia from June to August (inclusive).

15660. **Glauert, L.** The Development of our Knowledge of the Marsupials of Western Australia. *J. R. Soc. W. Aust.*, xxxiv, 1947–48 (6 April, 1950), 115–134.

15661. **Guiler, E. R.** New Species of Astacilla from Tasmania. *Pap. Proc. R. Soc. Tasm.*, 1948, 15 Sept., 1949, 45–64, tfs. 1–8.—Family Arcturidæ (Crustacea): *Astacilla* Cordiner, 1795; its affinities with *Neastacilla* Tattersall, 1921, are discussed, and this last-named is relegated to the synonymy. Describes as new the following species which were all taken at the northern end of the D'Entrecasteaux Channel: *A. monoseta, A. inæquispinosa, A. unicornis, A. derwenti, A. oculata.*

15662. **Hindwood, K. A.** *Pardalotus xanthopygus*: A Competition in "Christening". *Emu*, xlix (3), Jan., 1950, 205–208.

15663. **Hindwood, K. A.** Breeding of the White-plumed Honey-eater near Sydney. *Emu*, xlix (3), Jan., 1950, 211–213.—*Meliphaga penicillata.*

15664. **Iredale, T.** Birds of Paradise and Bower Birds. 4to. 1950. Melbourne (Georgian House), pp. i-xii, 1–239, 1 map and 33 col. plates by Lilian Medland.—This work should be taken in conjunction with the author's paper in the *Australian Zoologist*, xi, 1948, 161–189, and in which reference is made to the plates in this then unpublished work. Of especial interest to students of Australian ornithology are those birds from Australia included in a work largely devoted to the Papuan avifauna. Of these may be cited the Rifle Birds, *Ptiloris victoriæ* Gould, 1850; *P. paradiseus* Swainson, 1825; *Craspedophora magnifica* Vieillot, 1819; *C. magnifica claudia* Mathews, 1917; the Trumpet Bird, *Phonygammus kerandrenii gouldii* Gray, 1859; the Bower Birds (Ptilonorhynchidæ): *Sericulus chrysocephalus* Lewin, 1808; *Prionodura newtoniana* De Vis, 1883; *Ailuroedus crassirostris* Paykull, 1815; *A. c. blaauwi* Mathews, 1912; *A. melanotis maculosus* Ramsay, 1875; *Scenopoeetes dentirostris* Ramsay, 1876; *Ptilonorhynchus violaceus* Vieillot, 1816, and subspp. *Chlamydera nuchalis* Jardine and Selby, 1830, and subspp.; *C. cerviniventris* Gould, 1850; *C. maculata* Gould, 1837, and subspp.

15665. **Johnston, T. H., and Muirhead, Nancy G.** Some Australian Caryophyllæid Cestodes. *Rec. S. Aust. Mus.*, ix (3), June 30, 1950, 339–348, tfs. 1–10.—Records four species from the intestine of the Australian freshwater Siluroid Catfish, *Tandanus tandanus* Mitchell. One form, *Balanotænia bancrofti* Johnston, 1924, was previously known from eastern Q'land, the other three are considered new: *Notolytocestus major* n.g. et sp.; *N. minor* sp.n.; *Biacetabulum tandani* sp.n.

15666. **Keast, J. A.** The Wood-Swallows. *Aust. Mus. Mag.*, x (2), March, 31 (=4 July, 1950), 55–59, illustr.—Popular account: *Artamus cyanopterus, A. superciliosus, A. personatus, A. leucorhynchus* and *A. maximus* (New Guinea), and *A. insignis* (New Britain).

15667. **Kinghorn, J. R.** Fauna. Reptiles. *Australian Fisheries*, 1950, pp. 45–48.

15668. **Kolosváry, G.** Neue Fundortsangaben über einige Balanidenarte und Daten zur Assoziation der Balaniden und Mollusken. *Veröff. Deutsch. Kol.-u. Uebersee-Mus. Bremen*, iii (3), 20 Nov., 1942, 300–309.

15669. **Kolosváry, G.** Les Coraux (Madreporaria) de la Collection du Musee National Hongrois. *Bull. Mens. Soc. Linn. Lyon*, xviii (1), Jan., 1949, 13–16.—Refers to species from the Pacific islands (including Australia).

15670. **Laseron, C. F.** Review of the Rissoidæ of New South Wales. *Rec. Aust. Mus.*, xxii (3), Jan. 27, 1950, 257–287, tfs. 1–94.

15671. **Lendon, A.** Australian Parrots in Captivity. (Cont.) *Avicult. Mag.*, lvi (3), May-June, 1950, 122–135, 2 pls.

15672. **Loaring, W. H.** Notes on the Chestnut-Shouldered Wrens. *W. Aust. Nat.*, ii (5), July 7, 1950, 108–110.

15673. **Loveridge, A.** On Some Reptiles and Amphibians from the Northern Territory. *Trans. R. Soc. S. Austr.*, lxxii (2), 30 March, 1949, 208–215.

15674. **McGill, A. R.** Australian Status of the Colombo Crow. *Emu*, xlix (2), Oct., 1949, 83–84.—*Corvus splendens.* Records of its arrival in Australia at Fremantle.

15675. **Marshall, A. J.** The Function of the Bower of the Satin Bowerbird in the Light of Experimental Modifications of the Breeding Cycle. *Nature*, clxv (4193), March 11, 1950, 388–390.

15676. **Mayr, E.** Taxonomic Notes on the Genus *Neositta*. *Emu*, xlix (4), April, 1950, 282–291.

15677. **Mitchell, F. J.** The Scincid Genera *Egernia* and *Tiliqua* (Lacertilia). *Rec. S. Aust. Mus.*, ix (3), June 30, 1950, 275–308, pl. xxviii, tf. 1–10.—A synopsis of the salient features and variation shown by species of these genera based on a series of approximately 475 specimens from the museums of S. Australia, W. Australia and Queensland.

15678. **Morris, Muriel C.** Dilation of the Foot in *Uber* (*Polinices*) *Strangei* (Mollusca, Class Gastropoda). *Proc. Linn. Soc. N.S.W.*, lxxv (1–2), 6 June, 1950, 70–80, tfs. 1–3.

15679. **Morrison-Scott, T. C. S., and Sawyer, F. C.** The Identity of Captain Cook's Kangaroo. *Bull. B.M. (N.H.) Zool*, i (3), March, 1950, 43–50, pls. 3–5.—The authors show that of three specimens of kangaroo obtained by Captain Cook's expedition at the Endeavour River only the skull of one of these was still preserved in the Museum of the Royal College of Surgeons in 1939. No trace of the other material has been found. From a photograph of this skull, destroyed by bombs during the recent war, they have come to the conclusion that it is the skull of a young Great Grey Kangaroo and they designate it as the photo-lectotype of *Macropus canguru* (Muller, 1776)—"Captain Cook's Kangaroo".

15680. **Munro, I. S. R.** A New Genus and Species of Transparent Gobioid Fish from Australia. *Ann. Mag. Nat. Hist.*, (12) ii (15), March, 1949 (=22 June, 1949), 229–240, figs. 1–11.—*Paraphya* g.n. Orthotype, *P. semivestita* sp.n. Type loc. Clarence River, N.S.W.; many additional localities from N.S. Wales and Queensland.

15681. **Munro, I. S. R.** The Rare Gempylid Fish, *Lepidocybium flavobrunneum* (Smith). *Proc. R. Soc. Q'land*, for 1948, lx, No. 3, issued separately 24 Nov., 1949; vol. issued 20 Jan., 1950, 31–41, tfs. 1–3, pl. 1.

15682. **Munro, I. S. R.** Fauna. Fish. *Australian Fisheries*, 1950, pp. 30–34, pls. i-vi.

15683. **Nichols, J. T.** Results of the Archbold Expeditions. No. 62. Fresh-Water Fishes from Cape York, Australia. *Amer. Mus. Novit.*, 1433, No. 7, 1949, 1–8.—Records 11 species of which the following are cited as new: *Therapon percoides yorkensis* n. subsp. Coen River. *Archeria* n.g. *A. jamesonoides* n.sp. Archer River. Material collected by G. M. Tate and H. M. van Deusen.

15684. **Ormsby, A. I.** The Marsh Snake (*Denisonia signata*). *Proc. R. Zool. Soc. N.S.W.*, 1948–49 (May, 1950), 29–31.

15685. **Pope, Elizabeth C.** When the Rains Come. *Aust. Mus. Mag.*, ix (12), July-Sept. (Sept. 30=Dec. 2, 1949), 420–424, illustr.—Mention is here made of certain animals which appear after prolonged rains. These are the Shovel-headed Garden Worm, *Placocephalus kewensis*; the Blue Planarian Worm, *Geoplana cærulea*; the Amphipod, *Talitrus sylvaticus*; the Shield Shrimp, *Apus australiensis*; Ostracods and Fairy Shrimps, Estheria and Branchinella.

15686. **Robinson, A.** Observations on Courtship Feeding in some Australian Birds. *W. Aust. Nat.*, ii (5), July 7, 1950, 106–110.

15687. **Rochford, D. J.** Planktology. *Australian Fisheries*, 1950, pp. 27–29.

15688. **Ronsil, R.** Bibliographie ornithologique Française. Travaux publiés en langue française et en latin en France et dans les Colonies Françaises de 1473 à 1944. Tome I. Bibliographie, pp. 534, Frontispiece. *Encyclopédie Ornithologique* (Paul Lechevalier, Paris). Tom. viii (of this series), 1948 (1949).

15689. **Ronsil, R.** Bibliographie Ornithologique Francaise, etc. Tome II. Abbreviations des titres des Publications périodiques cités dans la Bibliographie Ornithologique Française et Index Méthodiques et Systematiques. *Encyclopédie Ornithologique* (Paul Lechevalier, Paris). Tom. ix (of this series).

15690. **Schultz, L. P.** Correction for "A Revision of Six Subfamilies of Atherine Fishes, with Descriptions of New Genera and Species". *Copeia*, 1950, ii (June 30, 1950), 150.—*Tropidostethops* g.n. to replace *Tropidostethus* Ogilby, 1895, præocc. Genotype, *T. rhothophilus* Ogilby.

15691. **Scott, E. O. G.** Neonatal Length as a Linear Function of Adult Length in Cetacea. *Pap. Proc. R. Soc. Tasm.*, 1948 (15 Sept., 1949), 75–93, tfs. 1–3.

15692. **Sedgwick, E. H.** Bird Movements in the Wheatbelt of Western Australia. *W. Aust. Nat.*, ii (2), Sept., 1949, 25–33.

15693. **Sedgwick, E. H.** Extension of Recorded Range of the Bourke Parrot (*Neophema bourkii*). *W. Aust. Nat.*, ii (3), Jan. 24, 1950, 67–69.

15694. **Sedgwick, E. H.** The Pallid Cuckoo in the South-West. *W. Aust. Nat.*, ii (5), July 7, 1950, 119.—Phenological notes which supplement those given by Dr. J. Gentilli (*q.v.*).

15695. **Sedgwick, E. H., and L. E.** An Esperance Bird List. *W. Aust. Nat.*, ii (5), July 7, 1950, 111–118.

15696. **Serventy, D. L.** Spare those Gannets! They point to Pilchards. *Fisheries Newsletter*, Sydney, viii (5), Aug., 1949, 12–13, illustr.

15697. **Serventy, D. L.** The Spread of the Mediterranean Snail (*Helix pisana*) on Rottnest Island. *W. Aust. Nat.*, ii (2), Sept. 16, 1949, 38–42, tf. 1–2.

15698. **Serventy, D. L.** Taxonomic Trends in Australian Ornithology—with Special Reference to the Work of Gregory Mathews. President's Address to the Annual Congress, Hobart, 1949. *Emu*, xlix (4), April, 1950, 257–267.

15699. **Shanks, D.** Observations from the Upper King River District, Victoria. *Emu*, xlix (2), Oct., 1949, 132–141.—Lists the birds in an area in north-eastern Victoria and gives notes and breeding records about them.

15700. **Sheard, K.** The Marine Crayfishes (Spiny Lobsters) Family Palinuridæ, of Western Australia, with Particular Reference to the Fishery on the Western Australian Crayfish (*Panulirus longipes*). *Bull. C.S.I.R.O. Aust.*, Melbourne, 247, 1949, 1–45, fig. 1 (map).—Lists the marine crayfishes of W. Australia and gives a working key to the genus *Panulirus*. The major part of the paper outlines the general biology of the species and describes the environment and fishing methods.

15701. **Sheard, K.** Factors in the Behaviour of Pelagic Fish Shoals in South Australia and New South Wales. (In Blackburn and Tubb, *q.v.*) *Bull. C.S.I.R.O.*, Australia, Melbourne, No.251, 1950, 72–74.

15702. **Sheard, K.** Fauna. Crustacea. *Australian Fisheries*, 1950, pp. 35–36.

15703. **Shipway, B.** Notes on the Natural History of the Pigmy Perch (*Nannoperca vittata*). *W. Aust. Nat.*, ii (1), June, 1949, 1–9, tfs. 1–5.—This fish inhabits coastal streams and marshes in south-western Australia in the area bounded on the north by the Moore River and on the east by the Phillips River. It occurs in fresh and brackish waters amongst stones and other débris with a preference for clear water. Notes are given on its habits, colour, spawning and development.

15704. **Shipway, B.** Notes on the Aquatic Natural History of the Lower Murchison River. *W. Aust. Nat.*, ii (4), May 17, 1950, 73–77, tfs. 1–2.—Eleotridæ: *Eleotris aurea* sp.n. (Golden Gudgeon).

15705. **Somerville, J. D.** Australian Cassowary: Corrigenda. *Emu*, xlix (3), Jan., 1950, 214–218, illustr.

15706. **Tarr, H. E.** The Distribution of Foreign Birds in Australia. *Emu*, xlix (3), Jan., 1950, 189–198.

College and from 1947 he spent two years in research at the Institute of Animal Pathology, Cambridge. He was awarded the Ph.D. degree for studies in ovine rickets.

R. H. Greenwood, of the University of Otago, has been appointed senior lecturer in Geography. He is a graduate of the University of Cambridge and has had extensive experience in oceanographical research with the British Admiralty and in the charting of the eastern Mediterranean with the Egyptian Government Survey Department. Dr. Arthur Boyd, who has been acting as Professor of Engineering, is retiring after thirty years' service in the University.

The University of Queensland was established in 1917 with faculties of Arts, Science and Engineering; Commerce was added in 1922; Agriculture in 1927; Dentistry in 1935; Medicine, Veterinary Science and Law in 1936; Education in 1945 and Architecture in 1946. The following table shows the total number of students that enrolled and sat for the annual examination in each Faculty at successive stages.

	1925	1937	1949
Arts	231	585	983
Science	52	106	526
Engineering	50	45	356
Commerce	11	106	476
Agriculture	—	15	48
Dentistry	—	39	242
Medicine	—	112	649
Veterinary Science	—	11	61
Law	—	10	72
Education	—	—	39
Architecture	—	—	49
Total	344	1029	3501

University of Sydney

Resignations from the teaching staff include: R. J. Lyons, Reader in Mathematics; Ida Browne, senior lecturer in Geology; C. A. Gibb, senior lecturer in Psychology; K. Viner Smith, senior lecturer in Pathology. A. J. Baker, formerly of Sydney and lately of Dundee, has been appointed lecturer in Philosophy.

The School of Public Health and Tropical Medicine is to be extended at an estimated cost of £169,000.

University of Melbourne

On the retirement of Professor Peter MacCallum from the Chair of Pathology, the degree of Doctor of Medicine *honoris causa* was conferred upon him. Professor MacCallum was born in Glasgow and educated in New Zealand, where he took degree in Science and Arts at Canterbury College. He stoked a ship to England to complete his medical course in 1914 and had a distinguished term of service with the Royal Army Medical Corps. He returned to Edinburgh, whence he was appointed to the chair in Melbourne in 1924, succeeding Sir Harry Allen. He became Dean of the Faculty of Medicine in 1939. He has been a leader in academic policy in the university. He has for some time been president of the students' Sports Union and he inaugurated the Reconstruction Training Benefits Scheme in the University. Among his services outside of the university have been his contributions to the design and organization of the Royal Melbourne Hospital and his origination of the Cancer Institute—of which the therapeutic services have been named the Peter MacCallum Clinic.

Professor G. W. Paton, who occupies the Chair of Jurisprudence, is to succeed Sir John Medley as Vice-Chancellor of the university. Dr. Emile den Tex, formerly of Leyden and Groningen, and at present working in the University of Sydney, has been appointed lecturer in Geology; he is a specialist in petrology. Dr. R. T. Patton has accepted a part-time position as lecturer in Ecology in the School of Botany.

Personal

Dr. Donald Thomson has been awarded the Ph.D. degree of the University of Cambridge for work on the social organization of the North Australian aborigines. Dr. Fritz Loewe has been appointed Assistant Observer with the 1951 French Antarctic Expedition. A. N. Hambly, senior lecturer in Chemistry in the University of Melbourne, will be abroad in America and at Oxford during 1951, for study of methods of research in chemical kinetics and chemical spectroscopy.

J. B. Brigden, formerly Professor of Economics in the University of Tasmania, Queensland State Statistician, and finance counsellor at the Australian Embassy in Washington, died in Melbourne on 13 October 1950 at the age of sixty-three years.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents.

Original Work

A Quantized Form of the Boltzmann-Maxwell Distribution Law

We have recently based the Antoine Vapour Pressure Equation (Antoine, 1888) on quantum dynamics (Gutmann and Simmons, 1950). Vapour pressure is only one of the many manifestations of the Boltzmann-Maxwell Distribution Law, and we have now found that many colligative properties of matter obey a law

similar in form to the Antoine Equation, viz.:

$$\log q = A + B/(T+C) \qquad \ldots\ldots\ldots\ldots (1)$$

Such manifestations which we have so far investigated are the viscosity and electrical conductivity of liquids, the thermal conductivity of gases and the electrical conductivity of intrinsic semi-conductors (Bosson, Gutmann and Simmons, 1950) and of metals. For the case of vapour pressure, the applicability of equation (1) has recently been reviewed by G. W. Thomson (1946).

The classical Boltzmann-Maxwell Distribution Law

$$N_1/N_2 = Ae^{-E/kT} \qquad \ldots\ldots\ldots\ldots (2)$$

implies the absence of interaction between the two particle species (e.g., Lindsay, 1941) and in each of the above-mentioned cases leads to a form of equation (1) with $C \equiv 0$.

Least-square analyses of published observational data show that C does not vanish for real, interacting, systems; this fact requires that the activation energy E in equation (2) should be the sum of two parts, viz., a constant, temperature-independent activation energy E_0 and a temperature-dependent part, H:

$$\text{where} \quad E = E_0 + H \qquad \ldots\ldots\ldots\ldots (3),$$

$$H = -CE_0/(T + C) \qquad \ldots\ldots\ldots (4).$$

H may be interpreted as the interaction energy of the system.

Using reasoning analogous to that employed by us (*loco citato*) for the special case of vapour pressure, i.e., following Debye (1912) in considering the system as an assembly of Einstein oscillators, we find that C is given by

$$C = -\frac{3}{8}\theta + \frac{RT\theta^2}{20T^2} - \frac{RT\theta^4}{1680T^4} + \ldots. \qquad (5).$$

Herein θ is the Debye characteristic temperature, calculable from quantum dynamics as

$$k\theta = h\nu_{max} \qquad \ldots\ldots\ldots\ldots (6),$$

ν_{max} being the maximum vibrational frequency of which the system is capable. For $\theta \ll T$, i.e., for reasonably high temperatures, the series in equation (5) converges rapidly and can be approximated by

$$C = -\tfrac{3}{8}\theta \qquad \ldots\ldots\ldots\ldots (7).$$

Good agreement has already been found between the values of C calculated from vapour pressure data with those computed by means of equation (6) from the velocity of propagation of sound.

The introduction of a finite value $\neq 0$ for C therefore leads in first approximation to the following quantized form of the Boltzmann-Maxwell Distribution Law:

$$\frac{N_1}{N_2} = Ae^{-\frac{E_0 + \frac{3}{8}\frac{h\nu_{max}}{k} E_0 \Big/ \left[T - \frac{3h\nu_{max}}{k}\right]}{kT}} \qquad (8).$$

This then can be written in the simplified form

$$\frac{N_1}{N_2} = Ae^{-\frac{E_0}{k(T + C)}} \qquad (9).$$

A full account of this work and its implications will be published elsewhere.

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L. M. SIMMONS.

The New South Wales University of Technology,
Broadway, Sydney.
15 December 1950.

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Desert Soil Formations of Australia

In a comparative study of Australian, North American and European soils that has been recently published by C. G. Stephens (1950), the suggestion is made that three of the four major soil types of the arid regions, namely the desert loam, the stony desert, and the desert sand ridge systems, 'represent three degrees of balance between the eroding and depositional process' and differ only in the degree of deflation of the fine particles that has taken place. Stephens' accompanying diagram implies that these three soil groups occupy similar topographic positions.

Observations in this State lend no support to such suggestion. In New South Wales the stony desert group is much more extensive than is shown on Prescott's map, which shows only an area extending southward from the Queensland border to a short distance south of Milparinka. We have observed these soils to occur over a rather wider area in this northern section, to cover most of the Barrier Ranges lying north and west of Broken Hill; and also over a fairly extensive area lying between Broken Hill and Milparinka, from the main north road through Koonenberry and Gnalta; and extending in wide patches to White Cliffs. More restricted occurrences of them are scattered through the West Darling region.

Seif dune systems also occur much further to the eastwards; notable developments lying to the east of the stony desert formation in the north (east of Tibooburra), to the east of Lake Bancannia, as well as elsewhere, and extending 20 to 50 miles into N.S.W. all down the South Australian border about as far south as Broken Hill.

Our main point of disagreement lies in the fact that in New South Wales the stony deserts occupy always the upland areas, whilst the sand dune systems occupy the lower plains and basins. The local name for these stony soils is the 'Stony Downs', and at dusk or in a good season their long gentle slopes and treeless outlines are indeed strongly reminiscent of the Downs of southern England. The largely treeless character of these soils is most probably associated with their high clay content, and is in marked contrast to the thick growth of Mulga (*Acacia aneura*) which covers, or until recently covered, the sand dune systems.

The high clay content of these soils in a low rainfall area (six to nine inches per annum) is explained by the observation that they are found always on rocks such as shales, slates or mudstones. Their clay has consequently been largely pre-formed in an earlier geological era, although perhaps undergoing hydration at present under the influence of the sodium ion that has accumulated from cyclic salt. That the parent material and topographic position are the principal reasons for the occurrence of these soils in areas surrounded by sand deposits is supported by a difference that has been found between the clay minerals present. The clay in the Stony Desert soils is predominantly montmorillonite, whilst that in the sand dune systems is composed mainly of kaolinite together with the oxides or sesqui-oxides of iron and aluminium, which would agree with a lateritic origin for the sand of which the ridges are composed, as originally suggested by Whitehouse (1940). Lateritic residuals in fact still occur scattered through the areas occupied by the Stony Downs, and several have been described both in New South Wales and in Queensland (Kenny, 1934; Whitehouse, 1948).

The areas covered by the Stony Downs are entirely devoid of any sand ridges. On both the east and west sides of these areas, the heavy soil with its covering of stones slopes gradually downwards, and as lower levels are approached occasionally carries patches of sand which in parts form outrunners of the seif dune systems. More generally, however, where the stone-covered clay soil passes under the superimposed layer of sand, a flat sand is formed as a relatively narrow band around the more elevated stony soil. Examination of a section through the soil at such a point shows a light-textured surface soil overlying a much heavier textured subsoil, reddish brown in colour; the small cuboid structure of which gives place to large blocks in the deeper layers. The profile that has developed, pseudo-profile though it may be, has obvious resemblances to the desert loam profiles as described by Prescott (1944).

It would appear that, in New South Wales at any rate, the Desert Sand ridges, Desert Loams and Stony Deserts do not represent three stages differing only in the degree of deflation. Mechanical analysis shows, on the other hand, that the soils of the Stony Deserts in fact have a much higher clay content than do the Desert Loams, even in the surface soil. Moreover, the reduction of the velocity of the surface wind by the layer of stones is tending to make these soils areas of accretion rather than of deflation.

It is possible to present an alternative theory for the presence of the stony layer, but this will be developed elsewhere. The detailed studies from which the above observations have been derived are at present being prepared for publication in a more extended form. This note is intended merely to correct a misapprehension concerning the desert soil formations as they occur in New South Wales. Beyond this and certain minor matters, general agreement can be expressed with the rest of Stephens' paper, which is notable and an interesting study of the comparative morphology of soils.

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Soil Conservation Service of N.S.W.,
Bourke.
22 December 1950.

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Quantitative Estimation of Amino Acids on Paper Chromatograms

Of the many quantitative methods for amino acid estimation on paper chromatograms (Gordon, 1949), the spot area method originally proposed by Fisher, Parsons and Morrison (1948) presents a simple and convenient method of analysis. These authors found for both amino acids and sugars that a linear relationship existed between the logarithm of the spot concentration and the area of such a spot. The present note describes some results obtained with the spot area method when applied to two amino acids, viz., glycine and aspartic acid.

The chromatographic technique employed followed the standard procedure of Consden, Gordon and Martin (1944) except that an ascending method of solvent migration was used as suggested by Williams and Kirby (1948). The phenol used as the mobile phase was purified by the method of Hillis (1950). The ninhydrin spray consisted of 0·1 per cent. ninhydrin in wet *n-butanol* containing 1 per

cent. pyridine (Phillips, 1949). The usual drying temperatures (Berry and Cain, 1949) were observed and Whatman No. 1 paper was used throughout. The method adopted has been to apply duplicate spots (0·005 ml) of the known concentrations between 3 and 30 micrograms of the standard acids and then triplicate spots from the unknown solution, which must contain amounts of acid within this range. Rather than attempt to measure spot areas on developed chromatograms, direct photostat prints were made on Kodak reflex copying paper and areas measured on the positive with the aid of a planimeter. This procedure has eliminated inaccuracy in the delineation of the spot edges, because the acid spots on the photostat have sharp edges of contrast. To obtain maximum contrast a yellow filter has been used in making the negative of the original chromatogram. The photographic procedure with respect to exposure and development times has been standardized.

It has been found that area measurements of the same concentration may vary appreciably between chromatograms, but for the same chromatogram the gradients obtained by plotting logarithm of acid concentration *vs.* area of spot for both glycine and aspartic acid are equal. In all cases the latter acid exhibits smaller areas than the former at the same concentration.

From a series of analyses of mixtures of aspartic acid and glycine at various concentrations within the range specified and performed in triplicate on each of three chromatograms, the maximum error for the method has been found to be ± 5 per cent. This compares very favourably with the range of previously published quantitative paper-chromatography methods. The degree of error has been found to be largely attributable to differences in the paper supports; for on an individual chromatogram, if seven area measurements are made on each of the triplicate spots of the solution being analysed, the error has been found to be only approximately ± 1 per cent.

Results typical of those obtained are shown in Table I.

TABLE I
Chromatogram No. 6
Spot Area Measurements (Planimeter Units)

Amino Acid Areas	Acid Concentration (micrograms per 0·005 ml)					
	5	5	10	10	20	20
Aspartic Acid Spots	20 21 20	19 21 20	29 31 32	30 31 31	43 43 42	43 43 44
Glycine Spots	34 35 34	34 35 34	47 45 44	45 45 45	56 57 55	56 56 57

It can be seen that between triplicate readings of duplicate spots of three concentrations there is only a small variation in units of area as measured by the planimeter. It is from results such as these that reference graphs (logarithm of concentration against area) are drawn for each chromatogram. Unknown concentrations corresponding to known areas can then be obtained directly from the graph.

This technique is being used for quantitative studies of the adsorption of amino acids by sparingly soluble solids.

The investigation is being extended to other acids and more complex mixtures and a more complete account of the results will be published elsewhere.

F. BRYANT,
D. J. O'CONNOR.

Department of Chemistry,
University of Melbourne.
29 December 1950.

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The Chemistry of Bitterness in Orange Juice

1. *An Oxidation Product of Limonin*

Emerson (1948) isolated from orange seeds the bitter principles limonin ($C_{26}H_{30}O_8$), nomilin ($C_{28}H_{31}O_9$), and a compound, m.p., 315°C., designated *Substance X*. In this laboratory, benzene extracts of bitter juices and dried peels from Washington Navel, Valencia and Parramatta oranges have yielded chiefly limonin. Nomilin has not been encountered, but some batches of alcoholic mother liquors, after recrystallization of limonin, yielded a crystalline compound, m.p., 315-316°C, which is probably identical with Emerson's *Substance X*.

The same compound has now been prepared by oxidation of limonin with performic acid or permanganate and has also been isolated as a by-product in a number of other reactions involving limonin. It is not clear, therefore, whether the compound occurs naturally in oranges or whether it is an oxidation product of limonin formed during the extraction process.

The compound crystallized from absolute alcohol in silky needles melting with decomposition at 315-316°C (evacuated tube); $[\alpha]_D^{21}$ = −124° (in acetone). Mixture melting points between the 'natural' product and the two oxidation products showed no depressions,

Analyses:

(a) 'Natural' product
Found: C, 60·95; H, 5·93.

(b) Performic oxidation product
Found: C, 61·18; H, 6·22.

(c) Permanganate oxidation product
Found: C, 61·05; H, 6·38.
Calcd. for $C_{25}H_{30}O_{10}$: C, 61·21; H, 6·16.

The compound titrated in the cold as a monobasic acid; equivalent weight, 495. Calcd. for $C_{25}H_{30}O_{10}$, 490·5. Back-titration after saponification indicated the presence of three acidic groups; saponification equivalent, 171. Calcd. for $C_{25}H_{30}O_{10}$, 163·5. The compound was recovered unchanged on acidification after saponification. It appears, therefore, that the compound, like limonin, is a dilactone and that it contains in addition a free carboxyl group.

Microanalyses were made by R. B. Bradbury and W. Zimmermann, Division of Industrial Chemistry, C.S.I.R.O., Melbourne, and by E. Challen, Sydney Technical College.

This work forms part of the research programme of the Division of Food Preservation, Commonwealth Scientific and Industrial Research Organization. Further details will be published elsewhere at a later date.

B. V. CHANDLER,
J. F. KEFFORD.

Food Preservation Research Laboratory,
Homebush, N.S.W.
3 January 1951.

Reference

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The Action of Ketene on Amides

Methods for the acylation of amides by acyl halides and anhydrides to diacylimines of the type RCONHCOR' have been surveyed in a paper read by Polya, Spotswood and Tardrew at one of the sessions of the A.N.Z.A.A.S. meeting in 1949. The possibility of preparing diacylimines from amides and ketene was suggested during the discussion. Some experiments relating to this suggestion are reported in this note.

Ketene was generated from acetone in an apparatus similar to that described by Morey (1939). The generator was calibrated with water. The amides were fused in test tubes of about one-inch diameter and treated with known amounts of ketene at temperatures 10-15° above the melting points of the highest melting products which might have been expected to occur in the reaction mixture. Although a large excess of ketene was used in some experiments, the yields were low owing to insufficient times of contact, and much unreacted ketene leaving the reaction vessel was trapped in a scrubber charged with aniline.

Although amides react sluggishly with ketene, the method could be of value in some cases if the chemical engineering problems could be solved. One of us (D.N.P.) proposes to give further attention to this matter.

The reaction products were worked up by methods which have been described by Polya and Tardrew (1948) and Polya and Spotswood (1948). A few representative experiments are tabulated in Table I with yields calculated from the amides.

TABLE I

Reactants: Amides (mols)	Reactants: Ketene (mols)	Recovered Amide, per cent.	Other Products, per cent. yields
$AcNH_2$, 0·2	0·2	66	Ac_2NH, 21; trace MeCN
$AcNH_2$, 0·03	0·2	29	Ac_2NH, 56; see text
Ac_2NH, 0·1	0·2	72	Ac_3N; 11 resin
$PhCONH_2$, 0·1	0·1	52	PhCONHAc, 17; PhCN, 17

The diacetimide obtained from acetamide and a large excess of ketene are obtained in the form of an oil which deposits droplets of acetic anhydride from a cold aqueous solution. An ethereal solution of this oil reacts with sodium to give a yellow pasty solid which gradually changes into white granules of sodium diacetimide. The nitrogen content of the oil is approximately correct for diacetimide (N found, 14·17 per cent; calculated, 13·86 per cent.). After standing for a few hours in a sealed tube the oil begins to crystallize, and after eighteen to twenty-four hours transformation to normal diacetimide, m.p. 78°, is complete. The structure of the oil may be formulated tentatively as MeC(OAc):NAc. This substance has been studied previously by one of us (J.B.P.) and may account for the peculiarities of some diacetimide solutions which have been noted by Polya and Dunn (1950).

Formamide reacts vigorously with ketene and affords 0·1 per cent. formyl acetamide, traces of hydrogen cyanide and an unidentified oil in addition to unchanged formamide. The reaction of ketene with *n*-butyramide is very slow. Most of the amide may be recovered and the yield of acetyl *n*-butyramide is less than 0·1 per cent.

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University of Tasmania.
30 December 1950.

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POLYA, J. B., and DUNN, P. (1950): *Rec. Trav. Chim.*, 69, 1297.
——— and SPOTSWOOD, T. M. (1948): *Rec. Trav. Chim.*, 67, 927.
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Micro Ionophoresis of Inorganic Ions

Several workers have recently described ionophoretic or electrophoretic separations of proteins, peptides, or amino acids on strips of filter paper across which an electrical potential was applied (Wieland and Fisher, 1948; Durrum, 1950; Biserte, 1950). These workers all agree that a fractionation into three groups—cationic, anionic and neutral—is usually most satisfactory. Combination of partition chromatography with electrophoresis was also used for the separation of amino acids by Haugaard and Kroner (1948).

In this letter we wish to describe some successful experiments on the electrophoresis of inorganic ions. The method employed for this work is that of Durrum (1950), the apparatus being modified as shown in Figure 1.

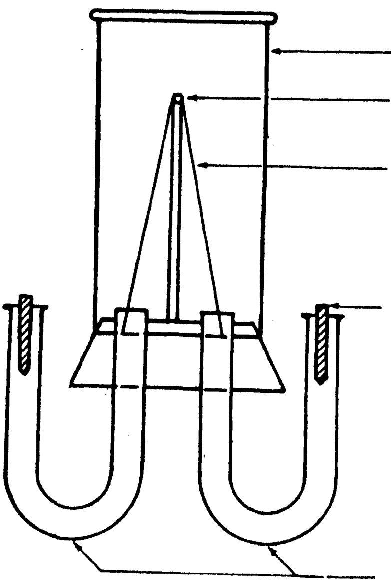

Figure 1

A drop of the solution to be tested is placed on the half-way mark (15 cm) of a paper strip 30 cm long and 1 cm wide. The strip is then bent, and placed, with the spot of test solution as apex, into the apparatus shown and the whole strip moistened with 1N hydrochloric acid from a pipette. Care must be taken that none of the test solution is washed away. This is best achieved by allowing some solution to ascend from both sides by capillary action simultaneously. The carbon electrodes are connected to a 70V d.c. supply, with a milliammeter recording between four and six ma of current. After one and a half to three hours the paper strip is removed and reagents added to detect the position of the ions in the test solution.

Using this method it was possible to determine the sign of a number of metal ions in a 1N hydrochloric acid solution, by observing whether the metals travelled towards the anode or towards the cathode. Table 1 shows the results so far obtained.

TABLE I

Metal	*Sign of charge*	*Metal*	*Sign of charge*
Mo^{VI}	positive	Fe^{III}	positive
As^{III}	positive	Co^{II}	positive
Cu^{II}	positive	Ni^{II}	positive
Hg^{II}	negative	Sb^{III}	negative
Pd^{II}	negative	Sn^{II}	positive
Pt^{IV}	negative	Pb^{II}	positive
Au^{III}	negative	Bi^{III}	negative
		Cd^{II}	zero

These results are of some interest in inorganic chemistry. For example, the results with molybdenum confirm those of Jander, 1930. Also, the anionic existence of mercury and bismuth, presumably as $(HgCl_4)^{=}$ and $(BiCl_4)^{-}$, is not generally appreciated and is shown unambiguously here. Cadmium appears to be at its isoelectric point, presumably as Cd″ and $(CdCl_4)^{=}$ in equal proportions.

While the method seems very suitable for the study of complex ions, we have also investigated its possible use in qualitative analysis and have been able to achieve the following separations.

Copper from Gold, Platinum and Palladium.—By ionophorizing a mixture of Cu^{II}, Au^{III}, Pt^{IV} and Pd^{III}, a mixed band of Au, Pt, and Pd travels toward the anode, while copper alone

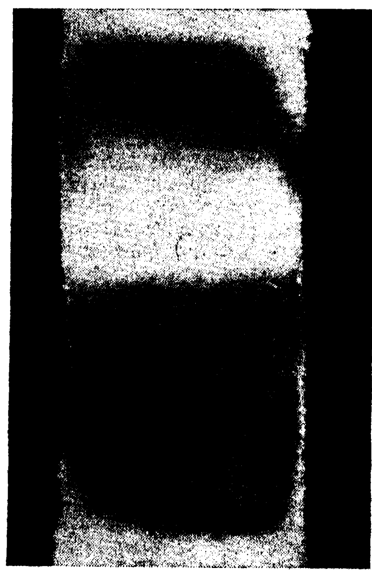

Figure 2

travels toward the cathode. After ionophorizing with 70 V for two hours, the paper is held over NH_3 and then over H_2S, giving a black band for Cu and a brown band for the mixed noble metals.

Bismuth, Cadmium and Copper.—A mixture of the chlorides is ionophorized for two to three hours and developed with NH_3 and H_2S, giving three well-separated bands of brown Bi_2S_3 on the side of the anode, yellow CdS on the point of application, and black CuS on the side of the cathode.

Mercury, Arsenic and Copper.—This mixture is separated into a band of mercury on the side of the anode and two adjacent bands of yellow As and black Cu on the side of the cathode, as shown in Figure 2. Copper travels farther than As, indicating that As is either retarded by adsorption or present as a monovalent ion such as AsO^+ (see Figure 2).

Antimony and Tin.—After one and a half hours at 70 V, two adjacent bands were obtained after passing H_2S: an orange Sb_2S_3 towards the anode and a brown SnS towards the cathode.

The investigations here described are only preliminary, and so far only one concentration of hydrochloric acid has been examined as solvent. Other solvents and other potentials are being examined.

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6 November 1950.

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Reviews

Acoustics

ACOUSTIC MEASUREMENTS. By Leo L. Beranek. (New York: John Wiley; London: Chapman and Hall, 1949. 914 pp., many text-figs. $8\frac{1}{2}'' \times 5\frac{1}{2}''$.) Price, $7.00.

This is a very necessary and worth-while book covering the field of electro-acoustics, as well as acoustic measurements. The author was the Director of the Electro-Acoustic Laboratory at Harvard, engaged on wartime acoustics and electro-acoustic problems. Much new information and data obtained during these investigations were available only through restricted sources, although in some cases they are now becoming available in the technical journals. Thus the book is of particular value to those who are now entering this field but who did not have access to the wartime developments.

The author states that the book is intended primarily as a reference for graduate students and workers in acoustics, and has attempted to cover the subject in such a way that the book will be an aid to five main groups of research workers; that is, the acoustic physicist, communications engineer, psychologist, otologist, and industrialist. While these are to some extent covered, the field attempted is so wide that there is some incompleteness between the various sections. There is so much of value for the physical worker and for those other workers with good physical training, that concentration on these aspects would have led to an improved and shorter text.

After somewhat long introductory chapters, there is an excellent chapter on 'Reciprocity Techniques for the Absolute Calibration of Microphones', with practical details. The author states:

> Of the principal methods for calibrating microphones, the reciprocity technique is the most accurate, at least for frequencies where the wave length is greater than the maximum dimension of the sensitive element. Reciprocity techniques can be used in either liquids or gases and require measurement of electrical quantities only.

On page 302 we reach the proper theme in the book in the chapter, 'Measurements of Acoustic Impedance'. Acoustic transmission line methods and acoustic bridges are described. There is a good general theoretical chapter on 'The Response of Rectifiers to Random Noise and Complex Waves', followed by very good practical chapter on indicating and integrating instruments for the measurement of complex waves. Corrections are set out for various meters to random noise and speech. This helps to clarify many difficulties found in practice. Corrections and methods are given for practical filters and for bringing to comparative basis measurements using different filters. Real voice and real ear methods of testing communication systems and articulation test methods are described.

Acoustic measurements of rooms and materials are included in about a hundred pages towards the end of the book. It is pointed out that while reverberation time is a most important variable, criteria for design may not be applicable to modern auditoriums. The limitation of the special Sabine formula in deriving absorption coefficients from reverberation measurements is discussed. Mention is made of a new school of thought which attempts to describe acoustical material in terms of its own properties and to bring in environment and

mounting conditions as separate items contributing to the effectiveness of the material in a particular application. The propagation constant and characteristic impedance are derivable with the aid of charts from basic physical properties of the material.

The book will be of great value to all workers undertaking acoustic and electro-acoustic measurements.

N. E. MURRAY.

Chemistry

THE CHEMICAL ELEMENTS AND THEIR COMPOUNDS. Volumes 1 and 2. By N. V. Sidgwick. (Oxford: Clarendon Press, Geoffrey Cumberlege, 1950. 1703 + xix pp., numerous tables. 6″ × 9½″.) English price, £3. 10*s*.

This book, of two volumes and 1703 pages, is one of the largest and most important textbooks of inorganic chemistry published in the English language. The monumental *Comprehensive Treatise on Inorganic Chemistry* by J. W. Mellor was much larger, and, whilst it could not be criticized on the score of completeness, was unselective and uncritical. The author merely recorded all of the available literature on the subject and left it at that. Unresolved contradictions were thus commonly encountered, even in succeeding lines. Sidgwick, whilst not nearly so comprehensive, is selective and critical—often quite forthrightly. A wide but selective survey of a field is probably the most valuable function of a textbook, not only to the student but also to the teacher and general research worker. The specialist working on an isolated topic can be expected to find his own way in the literature.

This book can be recommended to the worker in all branches of chemistry for its systematic no less than its attractive presentation of modern inorganic chemistry. As the author states in the preface, many textbooks on inorganic chemistry are so overladen with mineralogical, metallurgical and analytical details that the theoretical aspects of the elements and their compounds are nearly submerged. In this book such details are kept in the background. The periodic classification of the elements is taken as the guiding principle, since this in conjunction with the theories of atomic and molecular structure has lifted the subject from an incoherent mass of facts into an ordered system of relations. It might be advanced against the book that the space devoted in the Introduction to atomic and molecular structure is too limited. Further, it could be said that insufficient emphasis has been laid on the ideas of Pauling, that have been so fruitful in complex compound chemistry; that the value of redox potentials, magnetic properties and their basis could have been stressed. Undoubtedly these concepts and methods have been of the utmost value in co-ordinating the subject. In an inorganic chemistry text, however, the emphasis is properly on the elements and their compounds, and it is felt that the treatment of the theoretical basis is adequate.

The periodic groups are done in sequence, the first five groups appearing in the first volume. An innovation is the inclusion of carbon as a typical element in its proper group and not as the fruitful mother of organic chemistry. Each group is summarized for the important group properties of atomic size, covalency, valence variations, types of simple and complex salts. This is followed by a detailed discussion of the same nature of each element in turn. The complex compounds are discussed from the points of view of preparation, properties, stability and stereochemistry. Sections worth special mention for their excellence are hydrogen, the alkali metals and the halogens. A short discussion of the transuranium elements is included in Group 6.

The book is indexed for subjects and authors. Altogether, nearly 10,000 references are listed, in numerical order for each group. It is attractively printed and set up with a large number of tables. The structural diagrams are numerous and clear.

F. P. DWYER.

MOLECULES AND CRYSTALS IN INORGANIC CHEMISTRY. By A. E. Van Arkel. Translated by J. C. Swallow. (London: Butterworth Scientific Publications, 1949. 234 pp.)

This book is a translation of a third Dutch edition now in preparation. It is said to be intended for the first-year students in science and medicine. Although it may be usefully used in this way in Holland, it is very doubtful whether any first-year courses in Australian universities would cover the field of inorganic chemistry so exhaustively.

One of the main justifications for translating a foreign textbook is that it will afford access to a new and distinctive approach to a subject. No English text known to the reviewer covers the same ground in the same way as this one. Its stated aim is to interpret inorganic chemistry in terms of the ionic bond. The result is a volume that should do much to stimulate interest in structural inorganic chemistry. Although Van Arkel is clearly aware that the electrostatic theory of the nature of the chemical bond in inorganic structures can only be an approximation to the truth, one gains the impression on reading this book that overmuch prominence is given to the effect of bond type on physical properties. For example, in discussing the volatility of inorganic compounds, much is made of the idea of the shielding of a central positive ion by its surrounding negative

ions. That SiS_2 boils at a higher temperature (900°C) than CS_2 (46·3°) is attributed to the fact that Si^{++++} is not so well shielded by $S^{=}$ ions as C^{++++} is. This is no doubt part of the truth, but origin of the difference between the volatility of SiS_2 and CS_2 could have been made clearer by a reference to the known crystal structures of the two substances, which are entirely different from one another. SiS_2 is built up from infinite chains, whereas CS_2 belongs to the class of crystal built up from finite molecules. As Pauling has pointed out, volatility depends (mainly) not so much on bond type as on the arrangement and distribution of bonds.

It is difficult to understand what is meant by the statement, on page 50: 'Following this line of reasoning (concerning shielding) we should not expect to find volatile nitrides because such compounds would contain three N^{3-} associated with a positive ion which would have a valency of nine'. On page 114 it is stated that 'a bivalent positive ion has an ideal co-ordination number of four for monovalent negative ions'. There is no explanation what 'ideal' means in this context, but co-ordination number is largely determined by the radius-radio of positive and negative ions. It is not often that the opening sentence of a book calls for criticism, but the first statement in this one, namely that Lavoisier discovered the increase in weight of metals when calcined, certainly overlooks the work of Robert Boyle and Jean Rey.

These are some statements with which readers may take issue. The book is a mine of information and will well repay close study by more advanced students. In spite of its rather austere dust cover, it is well printed and clearly illustrated.

D. P. Mellor.

Progress in Chromatography, 1938-1947. By L. Zechmeister. (London: Chapman and Hall, 1950. 368 + xviii pp., 2 plates, 16 text-figs., 20 tables. 5¼″ × 8½″.) English price, £2. 5*s*. net.

An excellent review by Professor Zechmeister, designed especially for the chemist working with natural products and the biochemist. By giving brief extracts of the most important papers, the subject is presented to give sufficient details without requiring further reading. The theory of chromatography is only referred to and not discussed in detail, because, as Zechmeister points out, it has not influenced experimental work. Thus the main portion of the book deals with the chromatography of organic compounds, only twelve pages being devoted to inorganic chromatography. Partition chromatography is mentioned only in relatively few chapters, since most of the work in this field dates from 1947. The use of ion exchange resins, then in its preliminary stages, is also discussed only briefly. Valuable photographs of the Tiselius Claesson interferometric adsorption analysis equipment are included.

The bibliography contains approximately 1400 references and 'is not claimed to be exhaustive'. A. J. P. Martin (*Endeavour*, **6**, 21, 1947) stated: 'Chromatography has been so widely used in the last fifteen years that to give an adequate account of its achievements would be a problem as difficult as to give an account of the achievements of distillation'.

M. Lederer.

Directory

Directory of International Scientific Organizations. (Paris: UNESCO; Sydney: H. A. Goddard Pty. Ltd. (sales agent), 1950. 224 pp.) English price, 6*s*.

The Third Session of the General Conference of UNESCO, held at Beirut in 1948, resolved that UNESCO should intensify the systematic study of international non-governmental organizations in the fields of education, science and culture; and gather information respecting their composition, structure, management, means of support, etc.; and that the Director-General consider the possibility of publishing a *Handbook* of international organizations active in those fields. The *Directory* now published lists international organizations concerned with the basic sciences and the applied sciences, and includes other organizations which have a close relation to scientific activities. Examples of such are those for dealing with documentation, museums or films.

Brief, but remarkably complete, information is given of the aims, origin, finance, facilities, executive personnel and membership of all the various organizations listed in the *Directory*. This publication should be of great value to all those interested in or concerned with international co-operation in science.

G. H. Briggs.

Electronics

Advances in Electronics. Volume 2. Edited by L. Marton. (New York: Academic Press, 1950. 378 pp., numerous text-figs. 6″ × 9¼″.)

It is planned to publish one volume of *Advances in Electronics* each year. In this second volume of the series, authors chosen from among the leading workers in eight branches of electronics have presented, each in the space of thirty to sixty pages, reviews of recent progress in their special fields.

The subjects described are:

- Cathode Ray Tube Progress in the Past Decade with Special Reference to Manufacture and Design. By Hilary Moss (England).
- Electron Lenses. By P. Grivet (Paris).
- Field Plotting and Ray Tracing in Electron Optics: A Review of Numerical Methods. By G. Liebmann (England).
- Cathodoluminescence. By G. F. J. Garlick (England).
- Intrinsic Dielectric Breakdown in Solids. By H. Fröhlich (England) and J. H. Simpson (Canada).
- The Microwave Magnetron. By Gunnar Hok (U.S.A.).
- Ferromagnetic Phenomena at Microwave Frequencies. By G. T. Rado (U.S.A.).
- Microwave Spectroscopy. By D. K. Coles (U.S.A.).

In 'Cathode Ray Tube Progress'. Moss describes the different electrode constructions, processes, and techniques to be found, chiefly in English production, and makes interesting assessments of their value. A theoretical treatment follows, based on the author's application, in several recent papers, of the method of dimensional analysis to cathode ray tube design.

Both electrostatic and magnetic lenses are analysed by Grivet in 'Electron Lenses', primarily in their application to the electron microscope. The theory is extended to a consideration of lens aberrations and the image defects which result from small constructional errors.

Less accurate but more powerful methods of determining electron trajectories are appropriate to many other electron beam applications, and Liebmann's 'Field Plotting and Ray Tracing' summarizes analytical, numerical, graphical and experimental methods of finding, firstly the potential pattern, and secondly the electron paths. The large number of methods described are not considered simply as mathematical exercises, but attention is paid to comparative accuracy, relative labour, and practical points which are rarely mentioned—such as the complementary relationship between the circle and parabola methods of electron tracing.

In 'Microwave Magnetrons' Hok succeeds in compressing suitably the theoretical results and descriptions of present-day magnetrons and includes information on recent methods of modulation. 'Cathodoluminescence' discusses the observed characteristics of phosphors with reference to the needs of cathode ray tube screens and outlines recent theory.

The last three sections of the book move further into the domain of the electronic physicist. Measurements of the 'intrinsic dielectric breakdown', the value of field measured after all possible precautions have been taken to ensure that the results are dependent only on the sample, are shown by Fröhlich and Simpson to agree with the theoretical predictions for two temperature ranges in which different mechanisms apply.

Although much was learned of the behaviour of ferromagnetic materials at high frequencies by early investigators, very rapid progress has followed the recent introduction of precision microwave techniques. Rado, in 'Ferromagnetic Phenomena', discusses also the status of present theories extending the molecular field and domain concept to the microwave range. The activity in this field is shown by an addendum covering work published in 1949.

The microwave spectroscope has a shorter history, the first measurements of the ammonia absorption line being made in 1933; but the rapidity with which the body of published work has grown in the post-1945 period makes Coles' survey most valuable. The absorption lines which fall in the microwave region arise from molecular rotation, vibration, and other causes; it is now possible to measure the frequencies of these lines to a precision of one part in 10^6 or 10^7. The methods of measurement, and their contribution to exact knowledge of molecular structure and dynamics, are discussed. A point of interest is the proposal to use the technique for chemical and isotopic analysis. Interference between compounds would be small, for 'there appears to be room for a million separate lines in the presently accessible microwave region'.

It is a minor criticism of the volume that some authors use the symbol E to denote electric field, whereas others define it as potential, for which, inevitably, V and $\emptyset$ are used also.

Careful preparation is evident in each survey, and each contains a full bibliography. The departure made in including English and Continental authors in this volume, in addition to the American, has been most successful. The work is strongly recommended to all interested in these branches of research.

D. L. HOLLWAY.

Engineering

AIRCRAFT STRUCTURES. By David J. Peery. (New York: McGraw-Hill, 1950. 566 pp., numerous text-figs., tables and problems. $9\frac{1}{4}'' \times 6\frac{1}{4}''$.) Price, $6.50.

According to the author this book is intended for use as 'an undergraduate college text' and as such it concentrates to a large extent on basic structural theory and on the applications of aerodynamic theory to the determination of the air-load distribution over the aircraft. Although several minor criticisms can be made, the book is, on the whole, well written and covers most aspects of the subject. The author has evidently made a point of keeping the more

advanced mathematical analysis out of the book as far as possible, but in such cases reference is made to appropriate works.

A typical example of this is his treatment of the buckling of thin sheets. Here, the results of the mathematical analysis and the experimental behaviour of buckled sheets are described clearly and concisely, but the analysis itself is not included. Consequently this reviewer considers that the book does not by itself cover the subject to 'degree' standard; but if treated purely as a basic textbook and read in conjunction with the references given, it can be well recommended.

W. H. WITTRICK.

Enzymes

MULTI-ENZYME SYSTEMS. By Malcolm Dixon. (Cambridge: University Press, 1949. 102 pp., text-figs., tables. 4¾″ × 7¼″.) English price, 7*s*. 6*d*. net.

Achievements in the field of protein crystallization and the purification of macro-molecules have tended very greatly to obscure the fact that physiological properties of proteins operate in the 'impure' state. This is particularly so with enzyme proteins. Whatever the characteristics, physical and chemical, may be in the pure enzyme, the main interest must necessarily be in its behaviour when it is juxtaposed with those enzymes which catalyse reactions preceding or following the one it catalyses. If this juxtaposition involves cellular morphology, then the real physiological situation becomes ever more complex.

In the four lectures given in 1948 which make up this book, Dr. Dixon has examined enzyme kinetics from this point of view—that is, the enzymes as components of systems. The first lecture is devoted to an analysis of the glycolysis system. The second considers coenzyme linked reactions in relation to energy transfer. The third lecture examines the equilibrium constants of individual enzymic reactions with particular reference to oxidation-reduction potential and what the author describes as a new analogous scale of 'phosphate potential' for dealing with phosphorylation systems. The last lecture applies the concepts of *rH* and *rP* to selected multi-enzyme systems.

This is the most stimulating book on enzymes the reviewer has read. It is noticeable that the author has selected the best instances to illustrate his theories. Other instances would, in the present state of our knowledge, be explained only with great difficulty, if at all. The current intensive research in several institutions in U.S.A., however, on the role of coenzymes in aerobic phosphorylation, serves to emphasize the timeliness of this excellent set of lectures.

J. L. STILL.

Mathematics

FOURIER METHODS. By Philip Franklin. (New York: McGraw-Hill, 1949. 289 pp., 77 text-figs. 8¼″ × 5½″.) Price, $4.00.

The scope of this useful book is rather wider than is suggested by its title. It is divided into five chapters, each of about fifty pages. The first chapter is introductory and covers complex numbers and functions and the fundamentals of electric circuit theory. The treatment of Fourier series and integrals in the second chapter contains two valuable features: firstly, it is based on averages and discusses in passing matters such as the average power in a circuit; secondly, the periodic functions are chosen to have general periods such as $2\pi/\omega$ instead of the 2π usual in mathematical textbooks. The next two chapters are devoted to partial differential equations and the use of Fourier series in solving them, including a brief treatment of Maxwell's equations and wave guides. An account of the Laplace transformation is given in the last chapter (using what the reviewer supposes must be described as the 'not *p*-multiplied' form).

Only a knowledge of the calculus is assumed; the mathematics is taken slowly and carefully and with an adequate regard for rigour; and there are very liberal collections of examples. On the other hand, rather more familiarity with the concepts of physics and electrical engineering is assumed: the fundamental assumptions of circuit theory are stated very briefly, and a knowledge of Maxwell's equations and the vector differential operators is assumed in some places. The book is thus likely to be most suitable as a revision course in mathematics for students of electrical engineering who are beginning to feel the deficiencies of their mathematical training.

Clearly it was a good idea to collect under one cover the fundamentals of steady-state alternating-current theory, the basic Fourier mathematics, and the Laplace transformation. To the reviewer's mind, however, the author has stopped just a little too soon and does not make full use of this material. Thus, in the chapter on the Laplace transformation he does not mention the use of the expansion theorem in solving partial differential equations, and so cannot indicate the correspondence between solutions obtained in this way and those obtained by the use of Fourier series. Again, he does not mention the application of the Fourier integral to problems in circuit theory, or the relationship of this method to that of the Laplace transformation: these matters are vital ones for electrical engineers. In a new edition, the book would be greatly improved by an additional twenty or thirty pages covering these and similar matters. Meantime, it is one of the best books of its type which has yet appeared, and one which may well be useful in Australian university courses.

J. C. JAEGER.

Microbiology

INDUSTRIAL MICROBIOLOGY. By S. C. Prescott and C. G. Dunn. (New York: McGraw-Hill, 1949. 923 pp., 123 text-figs., 174 tables. 9″ × 6¼″.) Price, $8.50.

The appearance of a second edition of this book nine years after the first edition is of great importance to bacteriologists, biochemists and food technologists. This edition is half as big again as the first and five new chapters have been added to it: new work on saccharification, yeast production and yeast products, production and properties of butane-diol, the itaconic and related fermentations and antibiotics.

The first is an extensive account of the saccharifying agents available to the fermentation industries in North America. The chapter on yeast and yeast products includes the developments made in this field during World War II in England, Jamaica and Germany. Also during World War II the production of synthetic rubber drew attention to the need for more study of the butane-diol fermentation. An excellent summary of the production and properties of this substance is given. Two other fermentations studied during the same period, the ita-conic and ita-tartaric fermentations, are also considered. The chapter on antibiotics takes up about 11 per cent. of the total space in the book. It is an excellent account of the technical procedures known and used up to July 1948.

In every way this is an admirable book, the best of its field. It is indispensable for those working in industrial biochemistry and bacteriology.

J. L. STILL.

Nuclear Science

THE ACCELERATION OF PARTICLES TO HIGH ENERGIES. Based on a Session arranged by the Electronics Group at the Institute of Physics Convention in May 1949. Edited by H. R. Lang. Discussion edited by V. J. Francis. Foreword by M. L. E. Oliphant. (London: Institute of Physics, 1950. 58 pp., 9 plates, 15 text-figs. 6″ × 9″.) English price, 10*s*. 6*d*. net.

The writer of this review was fortunate in being present at the Institute of Physics Conference at Buxton in May 1949, and is very pleased that a full report of the last day of the conference, in which papers on the various types of particle accelerators were given, has been published. The development of high-energy particle accelerators is a recent one and it is difficult to obtain a connected account describing the principles of the various types of accelerators and information regarding their present limitations. Reports of some of the American and British machines which are in the process of construction are circulated to some of the senior scientists who are engaged in similar constructional work, but these reports are not readily available and their existence often not realized, and in any case much of the information is of too technical a nature for general publication. The result of this and the fact that few details have been published in scientific journals means that there are comparatively few people who are qualified to discuss these accelerators. It was therefore a very sound move to publish the talks which were given at the 1949 Buxton Institute of Physics meeting, as these were given by men who have been actively engaged for some time on the construction of accelerators and who are well acquainted with recent developments. In the publication there is also a detailed account of the discussion that followed the presentation of the papers.

There are four papers, and each is given a separate chapter in the book. The first deals with the cyclotron: it gives a clear account of the design and the limitations of the conventional cyclotron. It also deals with the design of the synchro-cyclotron and some details are given of the Harwell 110-inch and the Liverpool 156-inch pole-diameter machines. The second chapter deals with the principle of the betatron and the betatron-started electron synchrotron, and discusses their difficulties of operation. The various betatrons and synchrotrons in construction and in use in Great Britain are summarized. The third chapter discusses the problems associated with the pressurized electrostatic generator. It is rather surprising that after nearly twenty years the maximum voltage obtained from the electrostatic generator has not been increased to any marked extent. The effect of pressurizing the generator has certainly decreased its over-all dimensions, but the major limitation to the voltage obtained is the electric breakdown of the accelerating tube. The result has been that many generators are only giving about half of the voltage expected from the machines when they were originally designed. The reason for the voltage breakdown is not clearly understood, but the possible solutions that will resolve this limitation of the generator are along the lines of (*a*) increasing considerably the accelerator tube length and (*b*) having pumping systems at both the top and bottom of the column. Some discussion on this point did in fact take place at the conference, but this unfortunately has not been published in the book.

The fourth chapter is a brief one which deals mainly with the wave guide linear accelerator as designed by T.R.E. at Malvern. The final chapter is devoted to the discussion of the papers which took place in the morning following the conference. It is limited practically to

a discussion of the betatron and electron accelerators. Although it was clear at the discussion that some of the audience were particularly interested in these questions, it would perhaps been of more interest to the people reading the book if some of the other types of generators had also been discussed.

The main criticism which it is felt can be made is that a fuller account was not given of the proton synchrotron for energies of the order of 1000 Mev, as this would have improved the usefulness of the book and given a more complete picture. A recent article in the *Reports on Progress in Physics, 1950*, on cyclic accelerators does, however, cover the additional section and could be used to supplement it.

The book is very well illustrated and carefully indexed. A foreword by Professor M. L. Oliphant stresses the need for very large accelerators as well as much more careful experimental work from machines giving bombarding energies of the order of 10 million electron volts.

V. D. HOPPER.

Philosophy of Science

OUT OF MY LATER YEARS. By Albert Einstein. (New York: Philosophical Library, 1950. 282 pp. $5\frac{1}{2}'' \times 8\frac{3}{4}''$.) Price, $4.75.

This book is not, as the title may suggest, an autobiography of Einstein's covering his later years, but a collection of essays and addresses of the last fourteen years similar to the earlier anthology, *The World as I See It*. The themes treated in sixty articles are grouped under the headings: 1. Convictions and Beliefs; 2. Science; 3. Public Affairs; 4. Science and Life; 5. Personalities; and 6. My People. The spirit pervading the treatment of each and every one of this great variety of subjects commands our admiration, as it is deeply humane and mirrors not only the wisdom of the great thinker but the goodness of the great man whose cosmopolitan outlook transcends all national barriers. We know Einstein's highly ethical and utterly unselfish approach to all human problems concerning individuals as well as human society, and we see his political views in complete accordance herewith; as in advocating a supranational security system, a world government which he recommended as early as 1945. It is not only this ethical attitude which characterizes Einstein's political, religious, social, and educational utterances, but also an amazing impartiality and tolerance. These two qualities are also typical for Einstein the scientist-philosopher.

Besides Groups 4 and 5, it is chiefly Group 2, 'Science', that will be of special interest to the readers of This JOURNAL. Though there is in this group only one hitherto unpublished article ('Time, Space, and Gravitation'), the collection is greatly to be welcomed. Not only does the reader find two popular papers dealing with the equivalence of mass and energy, one of them containing an elementary derivation of $E = mc^2$, and two very short and easily intelligible presentations of the Theory of Relativity, but also papers of fundamental importance which may not have been generally known as they have been available only in scientific journals.

Among other problems, Einstein treats in 'Physics and Reality' and 'The Fundaments of Theoretical Physics' one of the most interesting and important questions: that of a complete theory of Physics, a question which has for some time been the centre of discussion in theoretical physics. He refuses to believe that physicists must abandon actually and for good the idea of direct representation of physical reality in space and time, or that they must accept the view that events in nature are analogous to a game of chance. He demonstrates why he feels that the basic idea of contemporary statistical quantum theory will not provide a useful basis for the *whole* of physics. The programmatic aim of all physics is for him the complete description of any individual real situation, whereas quantum statistics describes what Einstein calls 'an ideal ensemble of systems'. What he expects from a physical theory is a description of the events themselves, and consonance with the facts.

[It may be mentioned that those interested in these most controversial points of modern theoretical physics will find them discussed in detail by Einstein, Bohr and others in *Dialectica* (1948), and in *Einstein: Philosopher-Scientist*. The Library of Living Philosophers, Vol. 7 (1949).]

The generalized general theory of relativity, an amended version of which is to be expected in the near future, is not dealt with in this book. The English wording in some places obscures the meaning of Einstein's words, as for instance on page 55 in the formulation of the special principle of relativity. This well-selected collection of essays is attractively produced and will be of interest to the scientist as well as to the general reader.

ILSE ROSENTHAL-SCHNEIDER.

Physics

VACUUM EQUIPMENT AND TECHNIQUES. Edited by A. Guthrie and R. K. Wakerling. National Nuclear Energy Series, Manhattan Project Technical Section; Division I, Volume I. (New York: McGraw-Hill, 1949. 264 pp., numerous text-figs. and tables. $9\frac{1}{4}'' \times 6''$.) Price, $2.50.

The technique of producing and maintaining high vacua has undergone such phenomenal

development in recent years that it has become increasingly difficult to keep pace with all of its ramifications. This applies more particularly to that side of the subject which is concerned with large kinetic vacuum systems such as are used in nuclear physical research and industrial processes. The whole of this field abounds in difficulties and pitfalls, and it becomes correspondingly important to place at the disposal of the vacuum physicist and technician all the hard-won experience of those who have worked in it. Much of this experience has been gained during and since the last war, notably in the course of developing high-vacuum equipment for use in electromagnetic separation plants, under the 'Manhattan Project'. This equipment was on a scale never previously undertaken, and its development necessitated a considerable amount of pioneering work. The book under review, written in the main by those who were actually engaged in this work at the Radiation Laboratory of the Physics Department of the University of California, brings together this and related experience as an integrated whole.

The book is divided into five roughly-equal chapters. In the first are discussed the fundamental physical considerations on which high-vacuum technique is based. Chapter 2 deals with the elements of a vacuum system; mechanical backing pump, oil-vapour booster pump, high-vacuum oil diffusion pump, cold traps, valves, interlocks and gauges. In Chapter 3 an excellent account is given of the principles and operation of the various types of vacuum gauges. Chapter 4 deals with vacuum materials and equipment; in it are discussed such topics as the welding of steel plates, stresses and the formation of cracks, the proper design and use of rubber gaskets, various operational protective devices, and the properties of rubber, vacuum greases, waxes, sealing agents and miscellaneous materials. Finally, Chapter 5 deals with leak-detection instruments and techniques, with special reference to the vacuum analyser and helium-leak detector, which were developed for use in the Manhattan Project and proved to be very sensitive instruments.

The book is not, and does not pretend to be, a complete treatise on vacuum technique. Thus among the topics not discussed, or dealt with only very sketchily, are molecular pumps, mercury vapour pumps, the theory of self-fractionating oil diffusion pumps, properties of glasses, glass-to-metal seals, degassing of metals, and the use of getters. Within its prescribed scope, however, the book is excellent, and can be thoroughly recommended to all those who work with high-speed kinetic vacuum systems.

The binding, paper, print and line drawings are all of high quality, and the book is well indexed.

A. L. REIMANN.

AN INTRODUCTION TO LUMINESCENCE OF SOLIDS. By Humboldt W. Leverenz. (New York: John Wiley, 1950. 569 pp., 143 text-figs., 23 tables, one chart. 6″ × 9¼″.) Price, $12.00.

Twenty-five years ago luminescence was little more than an academic curiosity, but the wide-spread technological use of luminescent materials over the past fifteen years has brought with it an enormous increase in the scientific study of the phenomena. The increased interest in the subject is perhaps not wholly attributable to its commercialization: of the properties exhibited by many defect solids, luminescence is certainly the most fascinating and is possibly the most fruitful in providing information on the nature of the defect solid state.

This book is the first satisfactory monograph on the subject and is written by one who has contributed a great deal to many aspects of luminescence. The subject matter is certainly coloured by the author's own experience and views, with which not everyone working in this field will agree, but the material is co-ordinated and presented in a truly masterly fashion.

The book provides an introductory but fairly comprehensive text on luminescence and has avoided any intensive discussion of the controversial matters connected with the mathematical theory of the luminescence mechanism. The first chapter deals with the basic principles of matter and radiation and their interaction, and the second with the structure and energy levels of crystalline solids. In the following chapter the synthesis of luminescent solids is discussed; as Leverenz's most important contributions have been in this field, we may accept his statement that 'there is no effective substitute for personal experience in synthesizing phosphors' as an indication of the experimental difficulties involved. The remaining chapters are concerned with the constitution, structures and energy states of phosphor crystals, the mechanism of excitation and emission of luminescence, the general properties of phosphors, and the important uses to which they have been put. Throughout the text, the diagrams, particularly those representing the physical and energetic changes following absorption of exciting radiation, are outstanding for their clarity and instructiveness.

The last hundred pages are given over to appendices, glossaries, a comprehensive compilation of references and indices.

A. L. G. REES.

Plastics

THE STRENGTH OF PLASTICS AND GLASS. A Study in Time-Sensitive Materials. By R. N. Haward. (London: Cleaver-Hume, 1949. 254 pp., 108 text-figs., 57 tables. 8½″ × 5½″.) Price, £1. 10s. net.

This book is concerned primarily with the mechanical properties of plastics and glass, a subject which is becoming increasingly important as the great versatility of these materials is being gradually exploited. The materials considered show a wide variation in their properties, from the extreme brittleness and rigidity of glass to the toughness and flexibility of some of the plastics, and the properties discussed include both static and impact strengths and deformations. The author gives a very full account of research work carried out by other investigators, and a feature of the book is the extensive list of references at the end of each chapter.

The subject matter should prove of interest not only to engineers using these materials, but also (because of the fundamental nature of many of the problems discussed) to scientists interested generally in the properties of matter and the experimental and theoretical methods used in their investigation.

W. H. WITTRICK.

Veterinary Science

FERTILITY AND HATCHABILITY OF CHICKEN AND TURKEY EGGS. Edited by Lewis W. Taylor. (New York: John Wiley; London: Chapman and Hall, 1949. 423 pp., 796 text-figs., 48 tables. 5½" × 8½".) Price, $5.00.

The following appears on the dust cover and faithfully describes the book:

> *Fertility and Hatchability of Chicken and Turkey Eggs* can be used as a handbook by poultry breeders, hatcherymen and investigators in poultry husbandry, or as a textbook for courses in incubation and applied avian embryology. The book includes information from the fields of nutrition, physiology, biochemistry, biophysics, genetics and pathology. The authors aimed to review all phases of scientific work that has been done on the subjects of fertility and hatchability and to emphasize those which are of primary importance in actual poultry breeding or hatchery operation.

Included in the book are illustrations supplementing the text material, and an extensive bibliography citing pertinent references to related subjects. Authors of chapters include such names as Funk, Hinshaw, Romanoff and Landauer—world leaders in their particular fields. Each chapter has an index, and most have a summary or conclusions, thus making the book excellent for reference purposes. A glossary ensures that the layman can understand the text.

Printing, reproduction of plates and general set-up are splendid. The book is indispensable to any scientist associated with poultry research.

L. HART.

Zoology

PRACTICAL INVERTEBRATE ANATOMY. By W. S. Bullough. (New York: Macmillan, 1950. 463 pp., 168 text-figs.) English price, £1 8*s*.

This inexpensive compilation of 'brief and practical descriptions of the anatomy of those invertebrate animals which are commonly used as types' covers 122 genera which are commonly studied in Europe and North America, and these range from the Protozoa to the Cephalochordata.

With this range, one cannot expect an authoritative treatment throughout, and this is not given. Most of the type studies are followed by brief references to fuller description, and many of these are out of date. There has been a three years' delay between writing the preface and the book being published, so this would excuse an absence of the more recent information. It does not explain why, of the first 100 references quoted, 47 are pre-1900, and 24 of the remainder are from three very well-known sources.

In spite of this serious criticism, few errors are immediately apparent. One might have expected brief references to the exoerythrocytic cycle of *Plasmodium*, and the branchial crown of *Sabella* is drawn from an unnecessarily bedraggled specimen. The section on the liver fluke needs revision, and the diagram of the blood system of *Lumbricus* needs at least one arrow reversing.

The illustrations are a special feature and 'have all been newly drawn from preparations or dissections'. They are abundant throughout, and most of them are very good indeed, although at least three (Figures 57, 59, 63) could be bettered by a good student in a hurried laboratory session. In many cases heavy outlines add artistic merit in the Buchsbaum fashion, which is a fashion that the reviewer hopes will pass.

The book is evidently intended for use as a practical manual by senior undergraduates, and as such it provides, in a convenient fashion, a well-balanced fund of ordered information, not only on the types, but upon different methods of culturing and preparation. It is not, however, entirely adequate as a practical manual. On one hand it follows tradition too closely in avoiding the difficult but exciting business of studying the living animal. On the other hand, it completely eliminates that safe and essential standby—the transverse section. It deals with Atlantic rather than Indo-Pacific genera, and a conscientious Australasian lecturer will often need to revise the information given to make it of local application and to bring it up to date. In the end he will probably continue producing his own practical schedules, but will no doubt derive considerable assistance from Bullough's book.

W. STEPHENSON.

Book Notices

THE EARHART PLANT RESEARCH LABORATORY. By F. W. Went. *Chronica Botanica, 12*, 89-108. (Waltham, Mass.: Chronica Botanica, 1950. 20 pp., 1 plate, 2 figures. 7" × 10".) Printed for the Subscribers and Editors.

The Earhart Plant Research Laboratory was dedicated on 7 June 1949 to make possible the growth of plants under almost any combination of climatic factors, such as light, temperature, humidity, gas content of air, wind, rain, fog. By analogy with the cyclotron in physical sciences, it is proposed to call such a laboratory a 'phyotron'. The capital cost was given to the California Institute of Technology at the instigation of Dr. Robert Millikan by Harry Earhart, through the Earhart Foundation of Ann Arbor. The total cost of construction and equipment was $407,000. On the basis of an estimated annual running cost of $40,000, it is suggested that infection due to the entry of a single visitor might cost $10,000 in operating expense.

The publication gives the floor plans, and briefly describes the conditioning equipment, photo-recording equipment, utilities, and the manner of growing plants.

FIELD TRIALS II: THE ANALYSIS OF COVARIANCE. By J. Wishart. (Commonwealth Bureau of Plant Breeding and Genetics, Technical Communication No. 15, 1950. 35 pp. Obtainable from the C.A.B. Liaison Officer, 314 Albert Street, East Melbourne, C.2.) Price, 4*s.* 5*d.*

Written by the author of *Field Trials: Their Lay-out and Statistical Analysis* (published in 1940 and since reprinted) the present bulletin carries the subject into the domain of those topics which are commonly referred to as comprising the 'Analysis of Covariance'. The object is to assist the investigator still further in reducing his experimental errors by pointing out how observations made on variates other than those in which he is specifically interested may be used, by means of a special arithmetical technique, in the statistical analysis of his results. In so doing it is necessary to have an understanding of that part of statistical methods which deals with regression and correlation analysis. The object throughout the bulletin is to convey this information in non-mathematical terms, and to present the results in a computing technique which is as simple as it is possible to make it, and which can be followed by the experimenter who is unable to understand a mathematical treatment. Particular attention is directed to Tables 24 and 30, in which all the usual coefficients, including their tests of significance, can be worked out by very simple calculation. All the methods are illustrated by examples.

The two bulletins effectively cover the groundwork of the first half of *Principles and Practice of Field Experimentation*, by J. Wishart and H. G. Sanders, published in 1935 by the Empire Cotton-Growing Corporation and for long out of print. But they go much further; in particular the present bulletin deals with the cases of one, two and three affecting variates, and indicates how the methods can be generalized to deal with any number. A novel feature is the treatment of the problem of the difference between regressions in two correlated samples.

BIBLIOGRAPHY OF RESEARCH ON HEAVY HYDROGEN COMPOUNDS. By Alice H. Kimball. Edited by H. C. Urey and I. Kirshenbaum. National Nuclear Energy Series. Manhattan Project Technical Section, Division III, Volume 4C. (New York: McGraw-Hill, 1949. 350 pp. 9" × 6".) Price, $3.25.

This is a collection of about 2,000 references to the published literature on heavy hydrogen and its compounds, classified according to subject in such a manner that previous work may be readily found. It should be invaluable to investigators in this field.

ORGANIC SYNTHESES. Volume 29. (New York: John Wiley; London: Chapman and Hall, 1949. 119 + vi pp. 5½" × 9".) Price, $2.50.

This volume of *Organic Syntheses*, twenty-ninth in the series of annual publications of satisfactory methods for the preparation of organic chemicals, with C. S. Hamilton as Editor-in-Chef, is of the same high standard as previous volumes. It contains descriptions of satisfactory methods for the preparation of 1-acetylcyclohexene, acrylic acid, m-aminobenzaldehyde dimethylacetal, 5-amino-2,3-dihydro-1,4-phthalazinedione, β-benzoylacrylic acid, α-bromoheptaldehyde, tert.-butylamine and tert.-butylamine hydrochloride, Raney nickel catalyst, 4-chlorobutyl benzoate, 2-chloromethylthiophene, γ-chloropropyl acetate, 2,6-dichlorophenol αα-diphenylacetone, ethyl β-anilinocrotonate, ethyl 2-pyridylacetate, 1-ethynylcyclohexanol, homophthalic acid and anhydride, β-(2-hydroxyethylmercapto) propionnitrile, indazole, isoprene cyclic sulphone, methacrylamide, m-methoxybenzaldehyde, 1-methylaminoanthraquinone, 1-methylamino-4-bromoanthraquinone, 2-methyl-4-hydroxyquinoline, m-nitrobenzaldehyde dimethylacetal, p-nitrobenzonitrile, 5-nitro-2,3-dihydro-1,4-phthalazinedione, oleyl alcohol, α-phenylcinnamo-nitrile, protocatechuic acid, 2-thiophenealdehyde, 1,2,5-tri-hydroxypentane, trimethylene oxide.

THE PRODUCTION AND UTILIZATION OF SILAGE. A Review of World Literature in Abstracts. (Commonwealth Bureau of Pastures and Field Crops, Bulletin No. 40, 1949. 307 pp. Obtainable from the C.A.B. Liaison Officer, 314 Albert St., East Melbourne, C.2.) Price, 12*s.* 6*d.*

The abstracts listed in the first two chapters describe conservation methods in various countries, to assist the reader to obtain an overall picture. The next 121 pages describe techniques for ensiling specific crops and pasture herbage of various kinds.

Scandinavian and Finnish authors assert the superiority of A.I.V. silage, but opinions in the United Kingdom are divided on the value of using acidifying agents. American and Australian workers generally agree that a high-quality product can be made from pasture herbage without the addition of preservatives, provided that due attention is given to wilting the herbage before ensiling.

The chapter on digestibility and effects on animal products includes 223 abstracts. The last 29 pages deal with chemical and microbiological aspects of silage, and are thus of especial interest to workers in pure science.

RECENT ADVANCES IN FRUIT JUICE PRODUCTION. By V. L. S. Charley and others. (Comm. Bureau of Horticulture and Plantation Crops, Tech. Comm. No. 21, 1950. 176 pp. Obtainable from C.A.B. Liaison Officer, 314 Albert St., East Melbourne, C.2.) Price, 18*s.* 9*d.*

Descriptions are given of modern factory processes in American, European and Commonwealth countries. Citrus, apple, grape and tomato juices are dealt with in detail. Other products discussed include vitamin-rich syrups. Attention is paid to the relationship between de-gassing or sterilization and flavour or quality. A chapter on pectin-degrading enzymes is of particular interest to quality-control technicians. The book is copiously illustrated. It is prepared by a team of experts from Commonwealth countries.

INDUSTRIAL ELECTRONIC CONTROL. Second edition. By W. D. Cockrell. (New York: McGraw Hill, 1950. 385 pp., numerous text-figs. and tables, five appendices. 8½" × 5½".) American price, $4.00.

This book is written for the 'electronic service and maintenance engineer'. It deals in an elementary way with electron tubes, circuit components, basic electronic circuits, closed-cycle control systems and some electronic devices and circuits used in industry. The approach is descriptive, and little use is made of mathematics.

The Australian Journal of Science

Vol. 13 21 April 1951 No. 5

Various Approaches to the History of Science

ILSE ROSENTHAL-SCHNEIDER*

THE History of Science, which as a subject-matter of serious study is by no means new, has in our century become of much greater significance than it has ever been before.

In ancient times, when science and philosophy were still identical, problems of natural philosophy were frequently approached on the basis of 'historical' (in the broadest sense) investigations of earlier theories. Plato, for instance, based his whole doctrine on Socrates' ideas, and for the historian of science Plato's works (together with Xenophon's and Aristotle's) form the main sources of Socrates' teachings, of which no written documents are transmitted to posterity. The critical historical chapters on the first philosopher-scientists in Aristotle's *Metaphysics*—his history of science or natural philosophy—make delightful and informative reading. Aristotle deals with all the theories of the great men of antiquity, discussing their ideas chronologically and in a most frank manner, sparing none of them, least perhaps his teacher Plato. To Socrates he ascribes the important discovery of the method of Induction.

Since these early days the history of science has fascinated many a brilliant mind, and has been treated in various widely-diverging ways. The great significance, however, which the study of the history of science has assumed in our century may be traced back to several factors which help to explain—at least partly—the different approaches to this subject matter.

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There is first of all the realization of the fact that, in spite of all essential and necessary specialization, a unification of special sciences into 'science' as a whole (in the broadest sense, with the meaning of the Latin *scientia*, the French *science*, the German *Wissenschaft*) is imperative in our days. This would mean that each special problem which may be looked at as today's cross-section of the problem's whole development, must be studied and followed-up throughout the ages, with all its interrelations and concatenations in its own as well as in other branches of science. In order to attain the right perspective for the single specific problem, it is necessary to investigate its evolution chronologically and as fully as possible. Only in this way can the significance of a scientific result be adequately judged. None of the great men of science accomplished his achievements without making use of the work done by others before him in his own and frequently in adjoining fields of investigation. Sometimes even apparently completely different and independent subjects proved later on to be of significance to each other.

When this very broad view of the evolution of science is accepted, the task of the historian of science becomes immense. He has to write almost a history of civilization, not only of natural sciences. The collecting of innumerable items, and the selecting of the essential ones, seems in itself a project almost too extensive for one person to accomplish. Apart from the useful purpose answered by such a comprehensive historical work (that is, of helping us to understand a scientific problem thoroughly in its completeness), there is—on an international scale—another purpose: 'the unification and pacification of mankind', as George Sarton, the great protagonist of the history of science, expressed the aim of his efforts. He states that, in contrast to political, economic and religious imperialism, and similar attitudes

> —in the field of rationality and science, however, free from sentiment and from cant, some degree of objectivity is attainable, and here can be a consensus of opinion. It is for that very reason that science is the basis of unity and peace.

Whether we share this rather optimistic view or not, we must admire the work Sarton has accomplished with a view to such ends. The broad outlook involved by the 'comprehensive'

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approach cannot be better illustrated than by Sarton's standard works, the *Introduction to the History of Science*, of which the Third Volume recently appeared.* The creation of this Volume took twenty-seven years, a short time considering its content. Quite apart from the factual knowledge and from the understanding of scientific problems, the work achieved requires an extraordinary (and in its variety quite unusual) knowledge of languages; on which the reader (with his knowledge of, say, six or seven, and mostly only European, languages) must rely. He will confidently follow the linguist Sarton, the Orientalist and Medievalist, who had started as a young doctor in mathematical and physical sciences and whose purpose it was 'to explain the development of science across the ages and around the earth, the growth of man's knowledge of nature and of himself'. The means were the creation of a journal devoted to the history and philosophy of science (the first number of *Isis* appeared as early as 1913) and the composition of a 'manual wherein the main facts would be briefly recorded, together with enough bibliographical information to facilitate further studies'.

The scope of Sarton's new volume (covering the fourteenth century) shows the approach that we called the 'comprehensive' one, dealing with as many important details as possible, including their concatenations; laying emphasis throughout on strict chronology, and following Cicero's advice to historians: not to say anything false nor hide anything true, and to write without any suspicion of partiality or of animosity. This volume is 'a survey of science and learning everywhere in that century, a cross-section of the intellectual history of mankind at the level XIV'. Sarton stresses, himself, that such work cannot be thorough throughout; that it is 'necessarily incomplete and superficial because of its vastness: yet every question has been investigated as thoroughly as was possible without jeopardizing the whole'. He hopes that others will continue his exploration and promises to rejoice should his successors be led to new conclusions, even to conclusions discrediting or negating his own: he would be the first to give the new conclusions full publicity. Such an attitude shows clearly the spirit of the genuine scientific worker.

There are four guiding ideas in Sarton's work:

(1) the idea of unity;
(2) the humanity of science;
(3) the great value of Eastern thought;
(4) the supreme need of toleration and charity.

The idea of unity is an expression which needs some explanation. According to Sarton, 'the unity of nature, the unity of knowledge, and the unity of mankind are but three aspects of a single reality'. The great value he attributes to eastern thought is obvious in his thesis that the origins of western science (not only of religion and art!) are Oriental—Egyptian, Mesopotamian, Iranian—and that Arabic and other Oriental achievements were of extreme importance during the Middle Ages. Exploring the writings in many western and Oriental languages is important for a proper understanding of medieval science. 'For the purely Asiatic traditions the main languages are Sanskrit, Tibetan, Chinese and Japanese; for the western tradition . . . Hebrew, Greek, Latin, Arabic.' We learn that even for the western tradition two Oriental languages, Hebrew and Arabic, are needed. There will be very few then, indeed, fit for such exploration; for which—on the other hand—knowledge and understanding of scientific and mathematical problems is indispensable. (Apart from Czech, Icelandic, Korean, Persian, Polish, Russian, Syrian and Turkish, there are many languages dealt with whose names are not even known to the general reader.)

Sarton holds that the classification, Eastern *vs.* Western, is artificial, and that it 'runs across languages'. This, for instance, is one of the outstanding results which only the 'comprehensive' approach to the subject matter could bring forth. A rough sketch of the structure of the work will give an idea of its scope and illustrate its comprehensiveness. Volume III is divided in two symmetrical parts of 14 chapters each. The first chapters, that is, 1 and 15, are meant for consecutive reading, the others for consultation. Chapters 1 and 15 deal with the general historical background and

* INTRODUCTION TO THE HISTORY OF SCIENCE. Volume 3: Science and Learning in the Fourteenth Century. By George Sarton. (In two parts. Published for the Carnegie Publ. Institution of Washington, 1947. Part I, 1018 pp.; Part II, 1136 pp.)

The first volume appeared in 1927; the second, in two parts, in 1931.

provide a sort of synthesis of the material to follow, each containing 13 sections corresponding to the main chapters. It is therefore easy to make use of the Volume. The contents are classified under the headings:

I (XV). Survey of Science and Intellectual Progress;

II (XVI). Religious Background;

then, The Translators; Education; Philosophical and Cultural Background; Mathematics and Astronomy; Physics, Technology and Music; Chemistry; Geography; Natural History; Medicine; Historiography; Law and Sociology; Philology.

It is only natural that controversies concerning some points of Sarton's work have already arisen, and it is typical that we find in his own journal, the *Isis*, an echo of these controversies. No criticism, however, even if it should prove occasionally justified, can diminish the admiration for Sarton's outstanding work; for the accumulation of encyclopaedic knowledge in so many different subjects, on so many different persons and their works; for the clear, impartial and wise judgement, full of toleration; and, last but not least, for the most concientious study of original documents (so rare and yet so indispensable!) written in so many languages that hardly anyone—even a professional linguist—could master them all.

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A completely different approach to the History of Science is characteristic of works dealing with one branch of science only. Limiting one's subject like this does not, however, necessarily entail abstaining from the treatment of interrelations and concatenations of problems within one's own and with other scientific domains. It all depends on the historian's outlook whether it is narrow and merely limited to actual happenings, or broader so that he sees in their right perspective the many threads leading from one special fact or problem to others.

The compass of a work will naturally play an important part in the selection of material to be treated. We often find extensive fields of knowledge condensed into a single small volume giving merely the outline of the subject. The method of condensing may prove extremely useful when applied under the right conditions. These are mainly three:

(1) that the author is an expert in the whole vast field which he intends to condense;

(2) that the subject matter forms a coherent structure based on laws or principles providing a common foundation which interrelates the various parts of the whole;

(3) that the author adopts a definite standpoint from which he surveys the full sphere in order to make a selection suitable for his purpose.

Max von Laue's *History of Physics** may serve as an excellent illustration of this approach to the history of science: a treatment of only one subject during a definite period and in a comparatively small compass. von Laue presents the formation and transformation of some ideas important for today's physics. When the history of science or any part of it is treated as a history of problems in their evolution, a coherence and—to some extent, and inside a given framework—even 'completeness' may be achieved, despite the necessary condensation. It is this coherence and self-sufficient completeness which characterizes von Laue's *History of Physics*. To reproach him with any omissions of problems, of names or dates, would amount to a misunderstanding (though, referring to the epoch-making discovery of X-ray diffraction, he should at least have mentioned who had the ingenious idea of using an atomic grating for the diffraction of X-rays; that is, Max von Laue!). His approach, and the type of completeness attainable, are naturally widely divergent from those of Sarton, in his gigantic work. There is, however, the same genuine scientific spirit to be found with both, and so is the wish and hope to provide a 'world-wide unity of interest', an 'intellectual union'.

The history of physics lends itself readily to condensation according to the second criterion given above. The lawfulness of nature provides the common basis interrelating the various

* HISTORY OF PHYSICS. By Max von Laue. Translated by R. E. Oesper. (New York: Academic Press, 1950. 150 pp. 5½" × 8".) Price, $2.30.

The English translation is based on the Second German edition (1947), not the Third (1950), but the publishers say that it 'has been revised and brought up to date'. It is supposed that misprints and mistranslations will be rectified in the next English edition.

parts of physics, thus guaranteeing the intrinsic coherence of this subject-matter, the history of which is condensable for the same reasons. There is, we feel, no need to stress that we are indeed very fortunate in having von Laue's book, a work which not only conforms to the three criteria for condensability but which is from a man of von Laue's stature: from one of those very few who played a decisive part in the development described—and this in more than one branch of the subject.

The period treated is about from Galileo's time down to our days, stopping short at problems still under discussion. The problems are selected with a view to their significance for physics as a whole. Relations of physics to other sciences, and to technology, to religion, and to philosophy, are touched upon. One of the aims of the book is to demonstrate how deeply the intellectual achievements of physicists of the past three and a half centuries are reflected in the mental structure of modern man.

Kepler, Descartes, Leibniz and Newton are mentioned as having acknowledged the influence of religion on their scientific work. To everyone familiar with Descartes' works (and letters) it appears quite natural to find his name with the three others; though, strangely enough, a contrast in this respect has been recently construed by some authors. Religious thought affecting physical theories is illustrated by the interpretation of variation principles (as formulated by mathematicians, mainly in the eighteenth century). Hamilton's principle of Least Action, for example, was interpreted teleologically in contrast to the purely causal interpretation. Later criticism exposed the mathematical error (extremum but not necessarily minimum) in these interpretations; it thus helped to readjust exaggerated metaphysical speculations. There may be, however, according to von Laue, fundamentally a deep interrelation between a scientist's religiousness and his quest for truth in science . . . 'the search for knowledge without regard to its applicability for use . . .'; and just for the best of them the experience of scientific truth (*das wissenschaftliche Wahrheitserlebnis*) is in some sense a view of God—*theoria* (θεωρια).

von Laue mentions the remarkable contributions to science of men like Descartes, Leibniz or Kant, and deals with one of the most important questions of the philosophy of science —that is: What is the task of physical science? His answer is in line with Kirchoff's idea of 'description', describing the complex of connected processes as a whole, and describing it in the 'simplest' way. Such, and other, controversial issues are frequently touched upon: for example, in connexion with the validity of non-Euclidean geometries. The question of Gauss's co-ordinates in General Relativity and the principle of Covariance is not dealt with; that is why the Bridgman controversy on the value of the covariance principle does not arise. The revision of our idea of Substance, however, as necessitated through findings of modern physics, is treated and valued in all its importance.

All these considerations and highly interesting sidelights may be unexpected by the reader looking at the table of contents: Measurement of Time; Mechanics; Gravitation and Action at a Distance; Optics; Electricity and Magnetism; The Reference System of Physics; The Bases of the Theory of Heat; The Law of Conservation of Energy; Thermodynamics; Atomistics; Nuclear Physics; Physics of Crystals; Heat Radiation; Quantum Physics. The structure of the book as indicated in these headings does not at first sight suggest how many important problems apart from the evolution of physics proper are treated in this comparatively small book.

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Biographies of great scientists provide a third approach to the history of science. These biographies, apart from their psychological and general cultural interest, are of greatest value for the historian of science provided that they are written by an author who can see the life and work of the biographee in the proper perspective; who is able to understand his achievements in their historical setting.

A recent biography of Harvey Cushing* supplies an introduction to the historically interesting development of a branch (or rather several branches) of medical science, and gives at the same time for the 'general reader' a picture of this talented man and his various activities. The material which the author used

* HARVEY CUSHING: SURGEON, AUTHOR, ARTIST. By Elizabeth H. Thomson. (New York: Henry Schuman, 1950. 347 pp.) Price, $4.00.

in this biography is not the same as in Dr. John Fulton's biography: Miss Thomson gives a shorter and very readable presentation of her subject. She conveys some idea of Dr. Cushing's scientific contributions and 'his importance to this and succeeding generations'. We learn that Cushing, the pioneer in brain surgery, who so enormously reduced mortality in brain operations, was at the same time a 'humanist-physician', with a broad approach to medicine and to life. The growth of his various publications on many different medical subjects, in many of which he did pioneer work, is described most attractively, and his talents and interest furnish ample proof for the claim that Cushing was an unusual type of surgeon. His own interest in the history of medical science may have been stimulated by his friend Sir William Osler, whose biography he wrote after Osler's death. His first historical essay was written while he worked with Th. Kocher in Berne; it is entitled 'Haller and His Native Town'. As for many others, Haller the great physiologist and poet was of special fascination for Cushing, who kept up his interest in the history of medical science throughout his life, assembled an extensive collection of valuable documents and books, and so contributed to the study of the history of science in this way also, as well as by his contributions as an author in the field. Cushing's efforts to improve medical education in America, combining teaching and practical work at the hospitals, must have been quite remarkable.

The texture of the book is richly interwoven with threads leading to all the different branches of medical science whose progress Cushing influenced, and to the prominent personalities in these branches, of whom not a few were his close personal friends. The story of Cushing's life and work is therefore at the same time the story of the evolution of medical science in these branches.

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There can be no biography better than an autobiography as far as authenticity is concerned, but with a view to the historical setting this is of course different. Frequently the author of an autobiography will realize best when his ideas originated, how his works came into being, which influences were decisive, and so on; but rarely will he be able to judge the impact his work will have on the later development of science. The author, being an outstanding personality, will, however, see his own mental development in the light of the development of the science of his age. The scientific autobiography of Max Planck (reviewed in This JOURNAL, *13*, 59) for instance, gives us, besides some personal reminiscences and the development of his own scientific ideas, also a picture of those then prevailing in science, and of their evolution during his lifetime. Such an account, by such an eminent man, is therefore an invaluable document for the historian in science. The same applies to another illustration of this type: Einstein's *Autobiographical Notes*, or, as he says, his own Obituary, written at the age of sixty-seven (in *Albert Einstein, Philosopher-Scientist*, The Library of Living Philosophers, Volume 7, edited P. A. Schlipp, 1949). These autobiographical notes make fascinating reading, partly of course on account of the interest we take in the story he has to tell of his scientific development, partly, however, as first-hand information about the growth of scientific ideas as he has seen them growing during the period he can survey.

*Charles Darwin's Autobiography** is not like the two others since it gives many more personal details: his personal and scientific experiences, his family and friends, his teachers and their attitude, his favourite occupations, and his travels, and so forth. Quite apart from this, it reveals at the same time many historically interesting data, on generally accepted and on controversial theories in geology, botany and zoology in the nineteenth century. The book is therefore a contribution to the history of these three branches of science as well as an authentic document on the mental development and the attitude to life of an outstanding personality. We learn of Darwin's early 'taste for natural history' and for collecting all sorts of things: 'shells, seals, franks, coins and minerals'. He was as a boy interested in beetles and plants, in birds and fish, and had an ardent love for science—and just as ardent a drive to achieve and to be favourably known

* CHARLES DARWIN'S AUTOBIOGRAPHY, with His Notes and Letters depicting the Growth of the Origin of Species. Edited by Sir Francis Darwin. Including an introductory essay, 'The Meaning of Darwin', by G. G. Simpson. (New York: Henry Schuman, 1950. 266 pp.) Price, $3.50.

to the great scientists of his time. In 1831, at the age of twenty-two, he started, as a naturalist without pay, his long and eventful voyage on the *Beagle*. The geological, palaeontological, botanical and zoological observations were published, and facts in relation to the 'Origin of Species were collected on a wholesale scale'. He tried to explain to able men what he meant by 'Natural Selection' but even with his friends Hooker and Lyell he 'signally failed'. So there is, according to Darwin, no truth in the claim that the success of the *Origin* proved that 'the subject was in the air', or that 'men's minds were prepared for it' (page 56, *l.c.*). Not one of the naturalists he 'sounded' seemed to doubt about the permanence of species. In 1839 Darwin's theory 'was clearly conceived': the *Origin of Species* was published in 1859.

In 1858 Darwin received an essay from A. R. Wallace 'on the Tendency of Varieties to Depart Indefinitely from the Original Type', containing exactly the same theory as his. On the instigation of Lyell and Hooker, Darwin's abstract from his manuscript (of 1842 and 1844) and a letter (of 5 September 1857) were read, together with Wallace's essay to the Linnean Society on 1 July 1858 and published in the *Journal of Proceedings of the Linnean Society*, 1858, page 45. So it happened that Darwin's priority was saved. He reports that their joint production excited very little attention, and the only published notice he remembered said that 'all that was new in them was false, and what was true was old'. After 'thirteen months and ten days hard labour' the final manuscript was finished and published, under the title of *The Origin of Species*, in November 1859. Darwin's book was highly successful and was followed by a number of other publications about whose growth Darwin gives an interesting detailed report.

The autobiography in this book is followed by the third part, 'Reminiscences of My Father's Everyday Life', by Sir Francis Darwin. The man Darwin in all his human relations is vividly and affectionately depicted by his son, who gives, besides this picture, many incidental illustrations of historically interesting occurrences. In the following chapters we find a full account of the creation of Darwin's works, mainly of the *Origin of Species*, and this account, with Sir Francis's comments, represents—if we could call it thus—an approach to the history of science different from the three others that we have mentioned. Notes, sketches and letters provide the scientific evidence for the historian of science, who could not have a better guide than such first-hand information. Darwin's method of working, his difficulties and doubts, aggravated by bad health through many years, are obvious in these last chapters. Many of the letters would be worth quoting. On his main ideas he wrote to Hooker in 1844:

> At last gleams of light come, and I am almost convinced (quite contrary to the opinion I started with) that species are not (it is like confessing a murder) immutable. Heaven forfend me from Lamarck nonsense of a 'tendency to progression', 'adaptations from the slow willing of animals', etc.! But the conclusions I am led to are not widely different from his; though the means of change are wholly so. (Page 130, *l.c.*)

From the letters published in this book we learn much about the work of Lyell and Hooker too, which will be extremely interesting to the historians of geology and of botany.

Which of the widely-differing approaches to the history of science an author may choose depends on his individual attitude. Valuable contributions can be obtained from different viewpoints and in various ways.

The Forest Resources of Australia and their Potentialities *

D. A. N. Cromer†

Summary

Australia's forest resources have been estimated to cover 118-million acres of forested land, of which only 44-million acres are of saw-milling quality, and 28-million acres have been reserved by legislation. These areas represent 6%, 2·3% and 1·5% respectively of the total land area, compared with 27·6% of forested land for the world as a whole.

The annual production of sawn timber has now reached 100-million cubic feet and it is suggested that on existing standards the permissible cut from the productive forest area of sawmilling quality would be 159,000,000 cubic feet, and from State forests only 68,000,000 cubic feet.

* The first of a series of articles supplied through the Forestry and Timber Bureau (Commonwealth of Australia), 305 Collins Street, Melbourne, C.1.

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The requirements in locally-produced timber for a population of 12,000,000 (anticipated within twenty years), if the per capita consumption remains static, are 150-million cubic feet, which is more than double the permissible cut from existing State forests.

The productive capacity in the categories required industrially is unbalanced and abnormal, there being a marked deficiency in softwoods: an extension of coniferous planting is necessary to obtain the required balance.

A survey of resources, to confirm these estimates and form the basis for a national forest policy aiming at the conservation of the forest capital, is essential.

The conservation of land resources is dependent on an effective balance between agricultural and forestry usage. Agricultural land can only be utilized and conserved on a long-term basis if adequately protected from the effects of erosion, floods and wind by timber cover on catchment areas and higher ground, augmented by shelter belts and wood lots.

Consequently the need for forests for reasons other than timber production must not be overlooked. Such forests will include protection forests for the control of erosion and the regulation of stream flow, flora and fauna reserves, national parks, etc.

From the narrower viewpoint of commercial value it is necessary to examine our forest resources with respect to

(1) their extent and productive capacity, and

(2) their ability to meet future requirements.

Criteria of Resources

The criteria of a country's forest resources frequently used for comparative purposes are (a) the percentage of its area under forest, (b) the forest area per capita, and (c) the per capita consumption of forest products. Owing to the many variables involved, any one of these alone is unsatisfactory and even all three considered together must be viewed in the light of other mitigating factors, the chief of which is the rate of growth of its timber stands.

Statistical information (F.A.O., 1946) shows that the percentage of forested land for the world as a whole is 27·6%, a figure which cannot be taken rigidly since it includes densely forested undeveloped regions as well as devastated and desert regions with little or no forest area. Only in Europe can the balance between forest and agricultural land be said to approach equilibrium, and excluding the U.S.S.R. the percentage of forest in Europe amounts to 26·1%.

Relating forest area to population, the world figure for forest area per capita is 4·15 acres, and that of Europe 0·84 acres. Variation is considerable; from 137 acres per capita in undeveloped Alaska, 16·4 acres in Finland (predominantly a timber-producing country), down to 0·07 acres in the United Kingdom (the world's largest importer of timber).

The consumption of timber reflects the standard of living in a country and it is found that in North America the annual consumption of timber in the round for industrial purposes (excluding fuelwood) amounts to 70·6 cubic feet per capita compared with 17·7 cubic feet for the rest of the world and 28·2 cubic feet for Europe.

The Extent of Australia's Resources

The forest resources of Australia have not yet been completely assessed; and although a considerable body of information is available concerning areas under State forestry legislation, little is known of the resources on other Crown land or on private property. Timber derived at present from the two latter sources is considerable, but how much of such land will be devoted to timber production in the future is a matter for conjecture, since land settlement in most parts of the Commonwealth is not yet stabilized.

An estimate has been made, however, of the total forest area, based upon estimates by State forest services and modified by recent information from various sources, and these data are set out in Table I.

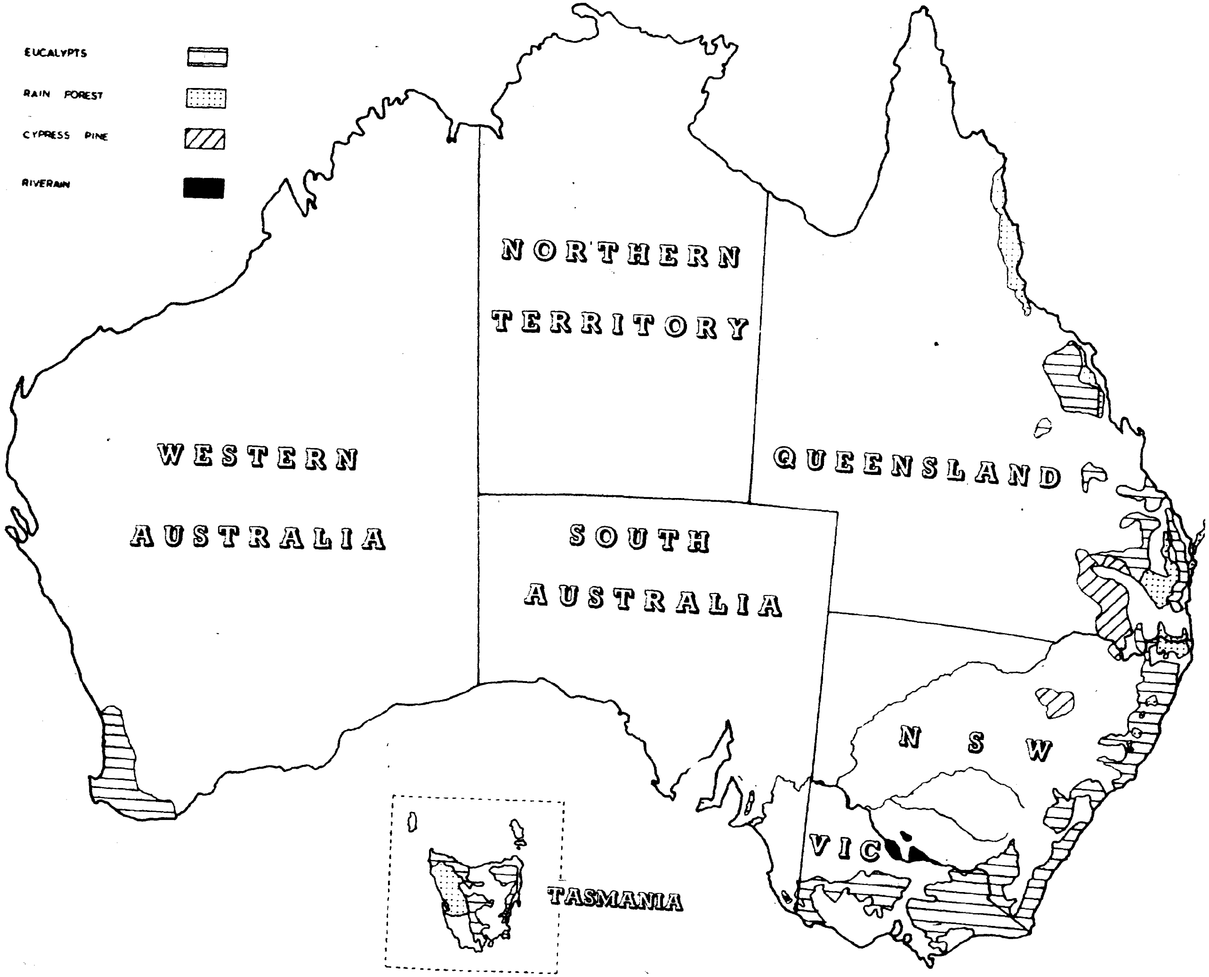
TABLE I

Total Area of Forested Land (excluding some poor forest in the Northern Territory)

(Thousands of acres)

	Total	*Eucalypt*	*Rain Forest*	*Cypress Pine*	*Coniferous Plantation*
Queensland ..	17,312	13,145	2,506	1,621	40
N.S.W.	30,000	28,055	600	1,315	30
Victoria	17,296	17,236	—	—	60
Sth. Australia.	6,597	6,467	—	—	130
West. Aust. ..	39,090	39,077	—	—	13
Tasmania ...	7,000	6,244	750	—	6
A.C.T.	243	228	—	—	15
Total	117,538	110,452	3,856	2,936	294
Percentage ..	100	94·0	3·3	2·5	0·2

In the Table are included all lands carrying timber of any kind in forest formation, but excluding savannah woodland. For example, the Western Australian figure includes over 19,000,000 acres of timber in the goldfields region, important for the supply of huge quantities of firewood and mining timber, and an additional 12,000,000 acres of forest capable of providing rough material only. The figures for



Figur

The Commercia Forest Regions of Australia.

Prepared by the Division of Forest Resources, Forestry and Timber Bureau.

Victoria and South Australia include several million acres of mallee, which provide firewood, mallee roots and eucalyptus oil; while that of New South Wales includes 4,000,000 acres of Hawkesbury sandstone and a considerable area of non-commercial forest.

In relation to the total area of Australia the percentage of forested land amounts to 6%, an extremely low figure, little greater than that of the United Kingdom. However, if the area of the Commonwealth supporting a population of less than one person per square mile is excluded (84% of the total—1947 Census), the percentage of forested land of what may be termed the 'inhabited area' reaches 38%. This figure presents the position in a much more favourable light compared with those of Europe and the world.

Figure 1 shows the location of the commercial forest regions of Australia and the area covered almost coincides with the population-density criterion adopted above.

Taking the round figure of 8,000,000 for the population of the Commonwealth, it is found that the forest area per capita equals 14·7 acres, which is considerably in excess of world and European standards. On the same basis the consumption of timber for industrial purposes in the round is approximately 32 cubic feet per capita annually, which is about one-half of that used in North America and slightly more than that consumed in Europe.

Productive Forest Land

An entirely different picture is nevertheless disclosed when only productive forest land is considered; that is, excluding forests of poor quality, inaccessible and unexploitable forests, protection forests, national parks, etc.

The following Table gives the area of productive forest of sawmilling quality, which includes private property and Crown land in addition to land held by forest authorities. This can be regarded as the maximum area of indigenous and planted forest at present available for commercial milling operations, and is likely to be further reduced by alienation and clearing for agriculture before the situation is stabilized.

TABLE II

Area of Productive Forest of Saw-milling Quality

State	*Millions of acres*
Queensland	7
N.S.W. (including A.C.T.)	12
Victoria	12
South Australia	0·3
Western Australia	
Tasmania	
Total	44·3

This area represents 2·3% of the total land area of Australia (14·4% of the 'inhabited area') and 5·5 acres per capita.

Approximately half of the productive forest area has been covered by reservations of one category or another, and about 43% (19,000,000 acres) has been permanently dedicated to timber production under the varying legislations of the different States. It can be stated that the highest quality forests have already been thus dedicated, but not all the Crown forest area is of high quality and much poor land is included in the classification of 'other' and 'timber reserves' in Table III.

TABLE III

Dedicated Crown Forest Area (excluding National Parks, etc.)

(Acres, as at 30 June 1949)

	State Forest	*Timber Reserves*	*Other*	*Total*
Qld.	4,022,520	3,117,574	—	7,140,094
N.S.W.	5,354,905	1,297,660	161,943	6,652,565
Vic.	4,222,040	717,453	161,943	5,101,436
S.A.	253,413	—	—	253,413
W.A.	3,402,963	1,789,623	1,038,000	6,230,586
Tas.	1,754,982	136,128	873,000	2,764,110
A.C.T.	—	—	131,000	131,000
Total	19,010,823	7,058,438	2,203,943	28,273,204

In relation to the total land area of the Commonwealth the reserved forest area amounts to 1·5%, representing 3·5 acres per capita. The discrepancy between these figures and those previously given for productive sawmilling forest is due to:

(a) considerable areas of Crown land carrying commercial forest of varying quality, the better of which State forest services are endeavouring to have dedicated; and

(b) alienated forest land for which information other than rough estimates is not available.

Little of such private forest is managed or protected and the time is not in sight when privately-owned forest will play a large part in Australia's timber economy on a permanent basis. This is in direct contrast to European countries, where private forests managed on a sustained yield basis often constitute the major forest resource.

Productive Capacity

The basic principle of forest management is the maintenance of the forest capital (i.e., the growing stock) and the utilization of not more than the increment or 'interest on capital'. In order that such a sustained yield principle can be put into effect it is necessary to know, firstly, the volume of the growing stock and, secondly, its rate of growth or increment.

While assessments of growing stock volume have been carried out on individual forests over a period of years, no comprehensive data are yet available from which the permissible annual cut can be determined. It must be realized

that standing volumes and rates of growth are very variable according to locality, site, species, quality, etc.; consequently a survey of resources is an undertaking of considerable magnitude.

Nevertheless, by the use of approximate mean figures it is possible to arrive at a reasonable estimate pending the compilation of data on a national basis. If it is assumed that the average growing stock per acre amounts to 400 cubic feet with an average increment of 2% and a sawn recovery of 45%, the permissible cut from productive forest land of sawmilling quality amounts to 159,000,000 cubic feet sawn, while that from State forests only must be limited to 68,000,000 cubic feet.

The annual production of sawn timber (including sawn and hewn sleepers) approached 100,000,000 cubic feet in 1948 (Rodger, 1948) and again in 1949, although these are considerably higher than pre-war figures. If the previous assumptions are correct, it is deduced that the State forest areas alone are inadequate to supply even three-quarters of our present requirements, and that the greater part of the productive forest land must be utilized to provide for population increases and increased consumption arising from further industrialization and increased living standards.

Deficiencies

Up to this point consideration has not been given to the various classes of timber produced or to the end-uses to which they are put. World industrial demand is for 85% of softwoods (coniferous timbers) and in the past Australia has attempted to satisfy this demand by the importation of softwoods, owing to her own deficiency in this respect. The indigenous softwoods of Australia were not extensive and commercial exploitation has reduced the standing volume to a low figure, while the sustained yield from a limited number of species will not exceed a few million cubic feet per annum.

Since the war the production of sawn indigenous softwood has been less than 25% of the total production and is expected to decrease steadily. Imports of softwood lumber have in the past brought the consumption to approximately 50% of the total consumption. There is no doubt that much greater quantities of softwood would be consumed if available. Approximately 27% of available supplies of sawn timber are utilized for cases and crates, and for this purpose softwood is far more suitable than hardwood. Australia has had of necessity to use hardwoods for cases, roofing timbers, plywoods, pulp, etc., for which softwoods are better suited.

To meet this deficiency all States have long since embarked on programmes of coniferous planting, utilizing in most cases poor land unfit for agriculture and previously carrying low-quality indigenous timber.

Australia can satisfactorily meet its requirements in heavy constructional timber, poles, piles, girders and sleepers; in structural scantlings, weatherboards and hardwood flooring, fibreboard, fancy veneers and cabinet woods. The position is unsatisfactory, however, in regard to plywood, softwood pulp, case timber, light structural timbers and softwood flooring; but this condition will steadily improve as more and more coniferous plantations reach utilizable size.

Deficiencies also exist in many special-purpose woods such as are required for pattern making, sporting goods, handles, aircraft construction, etc.; but the quantities needed are small and can be met by imports or the use of satisfactory substitutes.

There is no doubt that the softwood deficiency can be, and is already partly being, met by the establishment of coniferous plantations, both indigenous and exotic. The high total yields of such stands (up to 9000 cubic feet per acre), compared with that of the average native forest, enables rapid bridging of the gap.

Australian hardwoods are in demand overseas and one method of solving the softwood problem is to export hardwoods to offset the import of softwoods, thus providing by substitution a softwood-hardwood ratio closer to industrial demand. This practice has been effected on a limited scale in the past with New Zealand; however, it cannot be undertaken on a large scale if there are restrictions on imports for financial or other reasons and an unsatisfied market at home.

Future Requirements

Australia's ability to cope with future requirements rests therefore on the productive capacity of the forests and the degree of utilization obtaining. It can be assumed that the per capita consumption will not fall (except temporarily), but may rise slightly with increased industrialization and living standards. Further, it has been estimated by Clark (1950) that the population of the Commonwealth will reach 12,000,000 by 1970, and it is clear that an ultimate population of at least 20,000,000 must be envisaged.

Using the present local production figure and neglecting imports, the requirements for 12,000,000 people are 150,000,000 cubic feet sawn of native timber; and for 20,000,000 people, 250,000,000 cubic feet. The latter is about 60% greater than the whole productive forest land is capable of sustaining on existing standards, and based on the average values assumed earlier. The world as a whole is suffering from a shortage of wood and this country cannot expect in the future to import the large volume of timber needed to make up such a deficiency.

Provision for these future requirements lies in:

(a) increasing the productive capacity of existing forest stands;
(b) increasing the degree of utilization;
(c) afforestation with conifers.

The assumed mean growing stock of 400 cubic feet per acre can undoubtedly be improved by silvicultural treatment, while the lowering of the standard of utilization could perhaps double this figure by the use of secondary species, substandard logs, and material at present wasted, including sawdust.

Australia can meet its future commitments only by pursuing the three points of policy enunciated above.

Survey of Resources

It has been indicated that the absence of comprehensive data have made it necessary to estimate the yield from our productive forest land and to make certain assumptions. The volume of the growing stock and the increment per acre can vary within such wide limits according to site quality and species that the estimated means may not be very accurate.

In order to formulate a sound policy of sustained yield production it is essential that the total growing stock and total increment be determined in their various categories and classifications, so that the permissible cut may be stipulated.

The execution of a forest inventory over large areas is a time-consuming and expensive task, and can only be done on a percentage basis. In the past, assessment surveys have been carried out by ground survey strip methods, covering in most cases 10% or less of the total area. With the development of photogrammetric techniques it is now possible to combine aerial and ground surveys to achieve the same result in a fraction of the time and at greatly reduced cost.

The Australian Forestry Conference in Perth last year recommended 'an adequate inventory of forest resources and the growth potential of Australian forests' to form the basis of a national forest policy. It remains now for administrative action to put this resolution into effect.

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The First Pan Indian Ocean Science Congress*

V. M. TRIKOJUS

THE ravages of two world wars and the frightening prospect of another clash with newer weapons have combined to sharpen interest in the vital need to foster and maintain good relations between countries wherever possible. The first Pan Indian Ocean Science Congress provided an attempt to bring into closer alignment those countries where geographical contiguity has emphasized the existence of common problems and thus opened obvious avenues of useful contact.

Over the past thirty years the Pan Pacific Science Association, which was set up to represent the scientific instrumentalities of the countries bordering the Pacific Ocean, has met at approximately four-yearly intervals. At these congresses matters of common interest affecting the peoples of the Pacific have given focal points to the discussions. In the interim periods expert committees have been at work seeking to provide solutions to problems which seemed of immediate significance. In this way by cooperative effort advances in knowledge have been made which have had many practical applications. In January 1949, at a meeting of the Australian and New Zealand Association for the Advancement of Science held at Hobart, it was suggested by Professor A. D. Ross of the University of Western Australia that a body corresponding to the P.P.S.A., but pertaining to the Indian Ocean, should be set up and that a congress of interested countries should be called. This idea was taken up by the Australian National Research Council; it culminated in the acceptance by the Government of India of the proposal that India's central position should determine that country as the venue for the first congress. It was further agreed that this assembly should coincide with the Thirty-eighth Annual Session of the Indian Science Congress Association scheduled for January 1951. In this way delegates from the various Indian Ocean countries would also be enabled to meet conveniently the leading scientists from the numerous academic and research centres of India. Invitations were issued by the Government of India and by the Indian Science Congress Association to the governments of the various countries concerned, and through them to their respective senior scientific societies. In Australia this is the Australian National Research Council.

As a result of the generous interest of the Prime Minister, Australia was able to send a delegation of eight scientists, headed by the originator of the proposal, Professor Ross. The other members were Dr. E. G. Bowen (Chief of the Division of Radio Physics, C.S.I.R.O.); Professor S. W. Carey (University of Tasmania) Professor A. P. Elkin (University of Sydney); Mr. A. J. Millington (University of Western Australia); Mr. R. F. Thyer (Bureau of Mineral Resources, Melbourne); Dr. A. B. Walkom (President of A.N.Z.A.A.S.) and Professor V. M. Trikojus (University of Melbourne). Messrs. B. E. Butler (C.S.I.R.O.) and M. A. Condon (Bureau of Mineral Resources) were joined as observers. Most of the party travelled by air and assembled at the end of December in the delightful city of Bangalore,

* From the University of Melbourne *Gazette*, 7, 1 (March 1951).

the academic centre and administrative capital of the South Indian State of Mysore. The city has some of the attractive features of Canberra, being pleasantly elevated and with generous parklands and garden areas containing many fine administrative buildings and institutions, including the Indian Institute of Science. Here were gathered some 2000 representatives of the various branches of science, mostly Indians attending the Annual Session of the Indian Science Congress, but including the forty-odd delegates from Australia, Burma, Ceylon, France, India, Madagascar, Malaya (Federation of Malaya and Colony of Singapore) and Portugal, for the special purpose of the Pan Indian Ocean Science Congress. Indonesia, Pakistan and South Africa were unable to send delegations, but the hope was expressed that all countries would be represented at the next assembly. Among other foreign scientists present were those who had attended the symposium on Elementary Particles at Bombay, and participants in the celebration of the centenary of the founding of the Geological Survey of India.

On 2 January an impressive ceremony took place under an immense canopy of palm matting specially erected for the meeting in the spacious grounds of the Indian Institute of Science. It was attended by some 7000 persons. The Prime Minister of India, Pandit Nehru, who takes a keen interest in the scientific affairs of his country, flew from New Delhi, formally inaugurated both Congresses and then immediately departed for London to attend the Conference of Commonwealth Prime Ministers. His Highness the Maharaja of Mysore presided.

The deliberations of the Congress, under the chairmanship of H. J. Bhaba, F.R.S., President of the Indian Science Congress Association, were concerned for the most part with the drafting of the constitution of the Pan Indian Ocean Science Association and with the grouping of problems of common and immediate concern to the peoples of the Indian Ocean countries. It was resolved that the objects of the Association should be:

(a) To discuss concerted action in regard to scientific problems specially affecting the well-being of the peoples and the progress of the countries around the Indian Ocean, and to make recommendations to the Council of the Association for transmission to governments when necessary.

(b) To strengthen the bonds of friendship among all the peoples around the Indian Ocean by promoting a feeling of brotherhood among scientists and by the maintenance of harmonious relations between them.

It was also agreed that membership of the Association should be restricted to the independent countries around the Indian Ocean or to those countries having territories bordering the Indian Ocean. Thus in the first category India, Indonesia and Australia, for example, would be eligible, and in the second category Great Britain, France and Portugal. Each member country is to be represented on the Association by its leading scientific institution or by a body set up by its government for the purpose.

It is clear that the success of the Association will not be determined alone by pious resolutions. Much time was therefore spent by delegates on what one might call the dynamic functions of the Association. Specialist subcommittees were asked to determine the most urgent problems in the categories of Physical Sciences, Biological Sciences (including Nutrition and Public Health), Geological Sciences, Agricultural Sciences, Education and Social Sciences, and Geography and Oceanography.

Examples of projects considered to be of vital interest are:

- co-operative research into water and soil conservation;
- increased publicity as to the results of agricultural research and as to their more general utilization;
- the joint study of diseases of social importance such as malaria, tuberculosis, leprosy;
- the problems of industrial environments;
- the urgent need to collect together the oceanographical data already available, this to be preparatory to the establishment of a jointly controlled institute for oceanographic studies.

These and other problems will, it is expected, keep numerous groups of experts active in the interim period prior to the next Congress. At the final plenary session it was unanimously agreed that if possible the next meeting should take place in Australia, about August 1953. There seemed no doubt in the minds of delegates that this new association would, over the years, prove its vigour as equal to that of its sister association of the Pacific.

J. A. Prescott, F.R.S.

J. A. Prescott, Professor of Agricultural Chemistry in the University of Adelaide, and Director of the Waite Institute, has been elected a Fellow of the Royal Society of London. He graduated from the University of Manchester, and subsequently worked at Rothamsted with Russell. He arrived in Australia in 1925 to take up his present chair, and published the first comprehensive account of the soils of Australia in 1932. He has subsequently published many papers dealing with Pedogenesis in this country, and in recent years has paid particular attention to the development of climatic indices.

E.G.P.

The Activities of The Nuffield Foundation in Australia

Travelling Fellowships

SINCE the close of the 1939-45 war, the Foundation has developed a scheme of Dominion Travelling Fellowships. These Fellowships were originally given only to medical graduates, but their field has been widened, and the scheme now provides for the election each year of seven Fellows—three in Medicine (in the widest sense), two in the Natural Sciences, one in the Social Sciences, and one in the Humanities.

The object of these Fellowships is to enable first-rate Australian graduates to spend some twelve months in the United Kingdom obtaining research training and experience which will fit them for senior research and teaching posts in Australia. The emoluments of the Fellowships are generous, covering the fares of the Fellow and his wife and making adequate living allowances for the period spent abroad. Another valuable element of the awards is the readiness and ability of the Foundation to arrange suitable placement of the Fellows in universities and other research institutions in the United Kingdom. The quality of the candidates to whom these Fellowships have been awarded has been high, and the Foundation proposes to continue this scheme in the next few years.

Support of Research Projects in Australia

The Foundation now wishes to look for opportunities to foster research in Australia, and it is willing to give financial support, in a modest way, to research being conducted here. During its own comparatively brief history, the Foundation has always tended to support ventures which, while promising really significant fundamental results, are not likely in the initial stages to command support from other sources. It feels, too, that the work it supports in Australia should in general be work which calls on peculiarly Australian material and conditions. This has led to an expectation that some studies —for instance in fundamental biology—might have strong claims to assistance.

While the nature of this proposal does not lend itself to open competition of any sort, the Foundation will be glad to hear at any time of first-rate work which is thought to fall within the general description given above.

Research Opportunities for English Scholars in Australia

The Foundation is anxious to encourage United Kingdom graduates to come to Australia to work in fields where this country has exceptional facilities to offer. This is a difficult process to get started, for Australian research resources and opportunities are far from well known in the United Kingdom. It may well be that the best first step is to invite distinguished senior scholars to come from England (say for a term or two), to get to know what work is being done here; they would then be in a position to advise their more able graduate students, in suitable cases, to come to Australia to continue their research training. The Foundation is interested to have suggestions as to scholars who might be invited to come out, or in which fields a visitor might be selected.

Distinguished Visitors

Apart from the considerations mentioned above, the Foundation would like, from time to time, to invite senior academic leaders to visit Australia from England, or *vice versa.* While appropriate visitors could no doubt be found in all fields, the Humanities seem to have been somewhat neglected in this respect, and the Foundation wishes particularly to look in this direction for a number of its guests.

The object of these visits is not to provide a tour of inspection, accompanied by numerous public utterances, but to enable a true scholarly intercourse, in which the visitor would have leisure, peace, and financial means to pursue his own work and stimulate by personal contact the work of his Australian colleagues.

Farming and Metallurgical Awards

The Foundation also has a scheme of travelling scholarships for Australian farmers, and a series of travelling awards for metallurgists of various degrees of seniority.

The Foundation's Australian Committee

The Trustees of the Foundation have established a body of advisers in Australia. The general policy of the Foundation is framed, as far as Australia is concerned, after advice from a central committee known as the Nuffield Foundation Australian Advisory Committee, comprising Sir John Medley (Chairman), Mr. G. S. Colman, and Major-General S. R. Burston. The Secretary of the Committee is Mr. Maurice Brown, and its address c/- the Australian National University, Canberra, A.C.T. For advice on particular aspects of the Foundation's work and for the selection of candidates in specialized fields, the Committee calls on panels of experts selected for their eminence in the various fields of knowledge concerned.

The Foundation wishes that approaches to it concerning work in Australia should be made through the Committee.

A.N.Z.A.A.S. Brisbane Meeting May, 1951

Pre-Abstracts of Presidential Addresses

Section A: MATHEMATICS, PHYSICS, ASTRONOMY

Inductive Inference as Illustrated in Geophysics

K. E. BULLEN*

THE science of Geophysics, where uncertainties hit the investigator more forcibly than in some other branches of Physics, is particularly suited to illustrate a wide variety of questions of inductive inference.

On the simplest level, the pressure of unknown and uncontrollable factors results in a great spread of observational deviations and demands that special attention be paid to the use of statistical theory. This is well illustrated in the problem of constructing seismological travel-time tables, where standard errors have in the past twenty years been reduced from the order of 30 seconds to about 0·4 second in some instances, in a total travel-time of several minutes.

In mathematical and physical arguments, serious confusion often arises through failure to appreciate the distinction between 'mathematical models' and so-called physical reality. Is any scientific theory ever other than a mathematical model? The point will be illustrated by reference to the use of isotropic perfect elasticity theory in problems in seismology.

A third inductive question is that of the best procedure to follow in bringing together a series of working hypotheses. The fundamental rôle of probability will be stressed and illustrated in theories relating to the structure of the Earth's deep interior. One example will consider the combination of the three hypotheses:

(i) that the density jump from $5\frac{1}{2}$ to $9\frac{1}{2}$ g/cm^3 across the outer boundary of the Earth's central core is essentially a pressure phenomenon;

(ii) that compressibility changes smoothly (within certain limits) throughout the Earth below a depth of a few hundred km;

(iii) that the terrestrial planets are all of the same primitive composition.

This set of hypotheses leads to numerical results that agree with all relevant astronomical observational data within the standard errors of observation. The hypotheses are not thereby 'proved', but are appreciably raised in probability through the agreement.

Fourthly, the probability attaching to any scientific theory is a function of the evidence available as well as of the theory itself. This is illustrated by the fluctuating probability attaching to the resonance theory of the origin of the Moon, as the evidence has changed from the birth of the theory in 1879 to the present day.

Controversies on theories such as Continental Drift and estimates of the age of the Earth may also be discussed, if time permits, in order to illustrate important parts of inductive inference.

Reference will be made to the contribution to probability theory of the great geophysicist Jeffreys, in particular to his use of probability in developing a key theorem in inductive inference.

Although the illustrations given follow in the main normal elementary scientific method, it is well that the inductive aspects be stressed from time to time in these days of awesome material progress through high-precision experiment and dazzling mathematical techniques. The geophysicist feels that he has a special message to his fellow physical scientist because he is being so continually confronted with probability issues.

The moral is drawn that if the scientist of today who achieves concrete successes through his magnificent attention to technical detail can in addition bring himself to an ordered appreciation of the uncertainties that lie behind the broader inferences he makes—if he can bring himself to an appreciation of the problems of scientific inference in the widest sense—then he may perhaps be qualified to supply that inspiration which a sorely-tried planet needs today.

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Section B: CHEMISTRY

Some Australasian Plant Products

L. H. BRIGGS*

Through long separation from other land masses, both Australia and New Zealand have developed separate and specialized floras. Many plants, unusual from a botanical view, appear to produce unusual types of chemical compounds.

The results coming to hand from various workers on plant products in Australia, New Zealand and overseas, illustrate the amazing diversity of products elaborated by these plants. Completely new types of compounds, with novel combinations of atoms and arrangements of ring systems have been discovered.

The potential value of this plant chemistry will be discussed.

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Section C: Geology

Structural Control of Victorian Ore Deposits

D. E. Thomas*

Section D: Zoology

Zoological Research and Conservation Problems

Gilbert Archey†

Section E: History

The Roman Tradition

A. H. McDonald‡

An Ancient Historian presiding over a gathering of Modern Historians has reason to consider the relation of his branch of history to theirs: hence my subject, 'The Roman Tradition', with its broad implications in the study of European history.

We may begin with a glance at ourselves, who benefit from the work of distinguished predecessors in the field of Australian history, and I propose briefly to survey the past development, the present situation, and the aims of Australian historical studies, as in a country with a British background, a Pacific setting, and Asian connexions, all related to our own adaptation and progress. (This aspect will be treated with reference to Australian historians and their work.)

The Ancient Historian finds his relation to these studies in the necessity, in the New World, for proper understanding of the basic elements of our civilization, however we may have adapted them, and so his duty is to redress the balance of the New by reference to the Old World.

In this perspective the Roman tradition is important. We shall consider its influence, again briefly, with reference to Toynbee, the Roman Catholic Church, the Holy Roman Empire, and the Renaissance. Here the concept, rather than the reality, is the thing; but ideas are pervasive, and the present crisis of Western European civilization, in the face of developments in the East, brings the question near to us, as Pacific representatives of that civilization.

The Roman tradition which influenced Europe was exemplified in the peace and order of the Early Empire, with the material comfort and prosperity which it encouraged; its high point was the Antonine Age. If it then declined, it recovered again to inspire Diocletian and Constantine, in different circumstances, and to pass on its legacy to European civilization.

This Roman tradition was given practical form by Augustus, with the administrative system he established, and took on an appeal through the writings of Vergil and Livy. But they had to recall an early tradition which had been lost in the last disturbed century of the Republic. Cicero had defined it, putting into words the previous policy of Scipio Aemilianus, who faced the breakdown of the old order. This policy comprised unity within Rome and co-operation with Italy—a policy of balance. It was helped by Stoic influence.

The old Roman tradition rested on sound leadership by the great senatorial families, supported by the people. This unity was due to close social interdependence, as between patrons and clients, marked by *fides*, the strict observance of mutual obligations. Religion strengthened these bonds and, stressing the need for harmony between gods and men, induced the scrupulous attention to political and social relations which permitted development of the standard regulations of law.

This Roman tradition broke down when the conquests it made possible brought economic and social changes and the corruption of men by the power they gained. But the Romans had risen to their opportunities and, even in their later strife, did not forget the foundations of their greatness.

So the Roman tradition revived, when circumstances made this possible, and declined again only when circumstances once more changed. It passed on an influence which became effective wherever circumstances again allowed this possibility.

The ancient conditions were different from ours, but the principles of sound policy and administration remain the same. British policy picked up the Roman tradition, and as far as administration is still important, and we have a share in it, it is worth while historians gaining such a perspective as this and applying it duly in their study of modern problems.

Section F: Anthropology

A New Outlook on Physical Anthropology

A. A. Abbie*

Section H: Engineering and Architecture

Town and Country Planning in Australia Today: The Significance of Recent Developments

Denis Winston†

Unfortunately it is still necessary to explain the meaning of this subject of Town and Country Planning. Although the expressions 'Town Planning', 'Town and Country Planning',

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and today 'Regional Planning', have been more and more commonly used since the beginning of the century, their meaning is still popularly misunderstood and a limited definition in connexion with amenities, and what is often described as 'city beautification', is usually given to this subject. This misconception probably arises from the fact that the modern revival of town planning occurred at a time of maximum ugliness in city building and development.

This ugliness was merely the surface expression of more important social and economic evils, but the ugliness was more evident and less a matter for controversy; to attack it by means of tree planting and the provision of children's playgrounds was comparatively easy at a time when it would have been impossible to move against the real seat of the trouble. Yet the accumulating effects of congestion in the city and drift from the land, of wasted resources and spoiled assets, can no longer be obscured by flowers in the parks or statuary in the streets, and today the planner's concern is with the more fundamental matters of industrial location, land utilization and development, and the provision of essential services.

The interdependence of town and country, of the city and the hinterland which supports it, has been brought home through recent efforts at decentralization, when the question immediately arises: Decentralization to where? Particularly in the newer lands such as Australia 'country' or, more appropriately, 'regional' planning is seen to be a necessary preliminary to city planning. We are becoming more and more conscious of what has been described as 'the seamless web' of cause and effect, of influence and reaction, which links any one problem with wider and wider issues. This is the conception expressed by the word 'ecological' in the biological and social sciences.

The activities of the town and country planner impinge directly on the fields of economics and politics. This is through no wish of the planner himself, whose interest is in the physical arrangement of buildings and utilities, of land and landscape; he would like nothing better than to be given a clear programme to work to, to be told exactly how many and what kinds of factories to provide for, how many people to house in what kind of dwellings, and how many motor cars to accommodate on roads between given points. In practice, however, little of this information is forthcoming and the planner finds himself to be the only person who has given thought, however inadequate, to the overall problems involved: these problems are often of a political kind which the community is unprepared to face.

In another sense it can fairly be claimed that physical planning, which means the improvement of our natural and artificial environment, is non-political in character. The fair sharing of the wealth of the community and the achievement of higher standards of well-being at all levels of society is a plank in the platforms of all political parties. In this sense therefore the elimination of the slum, and the provision of adequate areas of open space for healthy recreation, is a policy agreed by all; as is also the proper conservation and development of national resources of all kinds.

We are in fact living in an economy which is very largely a planned one, the real planning instruments being those governmental agencies which control prices and credits, which make currency decisions and decisions regarding import duties and tariffs; which allocate grants for capital works, or control the supply of essential materials. There is no lack of planning therefore; the question is how can these policy decisions—which directly or indirectly govern the numbers and kinds of factories, roads, railways, power stations, and so on, to be built, and the kind and acreage of crops to be sown—be so directed and co-ordinated as to result in finer cities and richer countryside.

Our technical knowledge and skill is far ahead of our social, economic and political skill. We can make good plans but we have not yet learned the administrative art of carrying them into effect. In all large-scale administrative tasks the central problem is the problem of the proper devolution of responsibility. Planning must function well at all levels, from national to local, if it is to be successful, and the rate of progress will be that of the weakest member in the chain of authority. The present disorder in our cities and towns, and the conditions in rural areas which make most people long to leave them, is symptomatic of our failure to solve the broader issues of politics and administration; the improvement of these conditions, and the putting into effect of the remedies which have now been fully worked out by planners in many different parts of the world, awaits a further advance in the art of government.

Section K: Agriculture and Forestry

Subterranean Clover in the Agricultural Development of Western Australia

E. J. Underwood*

Twenty years ago the total area of sown pasture in Western Australia was barely 25,000 acres. At the present time the area is about 2,500,000 acres. This area is being rapidly extended, particularly on the light soils of the south and south-east where extensive post-war land settlement is taking place, and on the 'sand-plain' soils of the more favoured parts of the wheat-belt, hitherto regarded as of little agricultural value. Over a high proportion of this huge area subterranean clover is the dominant pasture species. It is apparent therefore that subterranean clover is a plant of

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major importance in the agricultural development of Western Australia and that it is extraordinarily suited to the soil and climatic conditions of the South-Western Agricultural Region of the Australian continent. This Region has an area of about 65,000,000 acres, only one-quarter of which has so far been cleared for cropping or sown pastures. It seems likely that subterranean clover will play a vital role in the development of much of the remaining 40,000,000 to 50,000,000 acres.

The South-Western Agricultural Region was remarkably free from indigenous ground flora suitable for grazing, although, by the beginning of the century, a range of poor annual grasses, clovers and 'composites', accidentally introduced from southern Europe and South Africa, had become established. These were unproductive, of relatively low nutritive value, and did not respond markedly to superphosphate. Subterranean clover of the 'Mt. Barker' strain was introduced to the State from South Australia by several farmers in 1907 and 1908. By 1914 the plant had become recognized as an outstanding pasture species and within ten years had become the principal pasture plant of the wetter parts of the Region. The next great step forward came with the 'discovery' by Mr. P. D. Forrest of the much-earlier-maturing 'Dwalganup' strain on his property at Boyup Brook. He recognized its immense possibilities for the lighter-rainfall areas of the Region and developed cheap and practicable methods of harvesting the seed. From that time 'Dwalganup' subterranean clover has been sown over rapidly increasing areas. At the present time a striking feature of this development is its extension into areas with an annual rainfall well below the levels previously considered limiting. On present evidence it appears that the outer limits for the successful establishment and maintenance of 'Dwalganup'-strain subterranean clover pastures coincide roughly with the 14-inch isohyet; but only, at or near these limits, on the lighter-textured soils. Attempts to produce new strains, adapted to even lower rainfall limits, are being made by A. J. Millington of the Institute of Agriculture of the University of Western Australia as part of an extensive pasture legume breeding programme.

The development of subterranean clover pastures has resulted in a marked improvement in stock-carrying capacity and in the nutritive value of the herbage. Improvement in soil fertility, particularly in the nitrogen and organic matter status of the soils, has been followed by striking increases in cereal crop yields on such soils and in the 'quality' of the grain. Soil erosion has also been arrested on many farms following the development of clover pastures.

The extraordinary suitability of subterranean clover to the Region and the consequent development of extensive areas of pastures dominated by this species, has resulted in the occurrence of a number of serious problems. Disturbances in the breeding performance of ewes and severe infestation with the Red-Legged Earth Mite (*Halotydens destructor*) and the Lucerne Flea or Clover Springtail (*Smithorus virides* L.) are the most important of these problems. Intensive investigation has been proceeding for a number of years and has already yielded very promising results for their control.

Section L: Veterinary Science

Cyclic Changes in Spermatogenesis in Rams

R. M. C. Gunn*

Section M: Botany

Viruses and Physiology of the Host Plant

B. J. Grieve†

Section N: Physiology

Extravascular Protein and Lymphatics

F. C. Courtice‡

Section O: Pharmaceutical Science

Modern Pharmacology and its Influence on Medicine and Pharmacy

R. H. Thorp‖

The early years of the twentieth century will always be remembered as marking the death of empirical therapeutics and the change from the use of drugs which 'do no harm' to those which 'do some good'.

Pharmacology in the modern sense dates back to the middle of the nineteenth century when the work of Magendie had shown that a rational basis for the action of drugs on the body must be forthcoming, and T. R. Fraser had started in motion the avalanche of research on chemical constitution and pharmacological action with his studies on the antagonisms of atropine and physostigmine.

By the first decade of the present century pharmacology had been made the subject of full chairs in several of the great universities, notably those of Edinburgh and London, and the literature was beginning to take a clearly defined form. Glancing through early records we find that in 1912 the physiological assay of drugs was 'brought prominently to the attention of the third-year class' in the Philadelphia College of Pharmacy, 'and for the first time in the history of the College the subject has been demonstrated on living animals'.

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For the young science of pharmacology there was an enormous virgin field to plough: all the plant drugs needed to be examined, the great number of impotent nostrums to be sorted from those which could be shown to have a rational basis, and the chemotherapeutic substances had yet largely to be synthesized and evaluated.

The research was at first wildly random and incoordinate but the boundaries of the field were thus explored. The pharmacological evaluation of established drugs was the principal aspect of this early work, but the coming of the vitamins and hormones tended somewhat to distract attention from these studies and to urge upon the pharmacologist the need for more accurate quantitative methods and the introduction of the methods of biological assay which form an integral part of pharmaceutical manufacture today.

The discoveries in chemotherapy shifted the emphasis from gross and general studies to the investigation of the chain of chemical reactions in the living cell. The studies of Loewi and Navratil on the inhibition of choline esterase by physostigmine in 1926 made the basis of enzymic interference clearly important in consideration of drug action, and today this approach is still the one of primary importance.

The new science welcomed to its following scientists trained in diverse fields, and the pharmaceutical industry became aware of the great prestige and renown which the development of new drugs might bring. Comparatively small firms, previously making simple symptomatic remedies, followed the larger companies by employing at least one pharmacologist; and from a small beginning in 1932 the British Pharmacological Society grew until its membership totalled over a hundred in 1945.

Modern pharmacology has had very striking effects upon medicine and medical education. No longer are experience and reputation the sole criteria for the selection of a therapeutic agent. The medical man, with pharmacology an integral part of his training, seeks scientific evidence and a rational basis for the use of a different drug.

The pharmacist is daily made aware of the progress in pharmacological research, and cannot escape the need for knowledge of the mode of action of drugs and the methods which are available to test and control them. It has been said that modern pharmacology is taking from the pharmacist much of the art which has been his right through the centuries; but again only pharmacology can give him that understanding of the scientific basis of modern medical research which will fit him for the role of an expert in drugs which must be his in the future.

The pharmacist, far from losing his identity, has a very great part to play, since he can share with the synthetic chemist and the pharmacologist the development of new therapeutic substances. With his specialized knowledge of the art of compounding drugs, better preparations can be made, the method of administration modified, and the duration of action of many drugs increased. To do this, however, a knowledge of more than the chemistry of the substance is surely desirable and the general principles of pharmacology assume an importance previously unsuspected.

Section P: GEOGRAPHY

The Mapping of Australia

L. FITZGERALD*

A broad interpretation of the term 'mapping' would include every operation from survey in the field to the ultimate publication of the map. The map itself might delineate topography, geology, vegetation, boundaries of property, or a scheme of regional development. When mapping is associated with a continent the size of Australia, it conjures up a task of such magnitude that one is inclined to think of its completion or even substantial progress in terms of the very distant future. This leads to an unfortunate resignation to tolerate a state of affairs under which developmental planning so frequently proceeds with inadequate basic data.

At the beginning of this century, the approach to the problem was not far removed from that of our intrepid explorers who faced the unknown with little else than stout hearts, horses, or camels, and who returned with narrow ribands of geographical data to supplement the otherwise blank spaces on our maps. Then followed the development of the modern motor vehicle and aircraft, which have practically eliminated distance and remoteness as adverse factors: then the aerial photograph, modern photogrammetric equipment, and radar for position determination have jointly revolutionized the technique of mapping.

Examples are legion of projects ill-conceived in the past because of the absence of, or inability to produce, a basic topographical map when required. Such should not occur in the future. Planners who can obtain their information from an air photograph will appreciate the progress already made in this respect. One million square miles of our territory have already been photographed, and the balance with current potential could be completed in less than ten years. The air photograph, however, should rightly be regarded in its true perspective as a new instrument in the hands of the surveyor or engineer; it does not constitute a map, the production of which still remains a laborious and time-consuming task.

It can reasonably be stated that the technical approach to mapping can be adequately mastered. The problem is to assess the real

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Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

April, 1951.

EDITOR: STEPHEN J. COPLAND, c.o. Linnean Society of N.S.W., Science House, Gloucester Street, Sydney.

Vol. 28 **No. 6**

ZOOLOGY.

Hon. Abstractor : A. Musgrave.

15707. **Tesch, J. J.** Heteropoda. *Dana Report* No. 34, 1949, 1–53, 44 tfs., 5 pls.—Species from Australian seas referred to in this paper are as follows: *Protatlanta souleyti* (E. A. Smith); *Atlanta turriculata* d'Orbigny; *Carinaria galea* Benson; *C. cristata* (Linn.); *Pterosoma planum* Lesson; *Cardiapoda placenta* (Lesson); *C. richardi* Vayssiere; *Pterotrachea scutata* Gegenbaur; *Firoloida desmaresti* Lesueur.

15708. **Thompson, H.** Pelagic Tunicates of Australia. (Issued by the Commonwealth Council for Scientific and Industrial Research, Australia.) 8vo. Melbourne. Pp. 196, pls. 1–75, tfs. 1–19. Printed 1947; title-page added 1948; issued 1950.—Though devoted mainly to the taxonomic aspect of this group of Tunicata, nevertheless attention is paid to distribution and ecology. The species are described and figured, the original authors' diagnoses being supplied in many instances, together with illustrations. Additional data and figures of Australian forms are, however, introduced, to supplement the work of past students in the group.

15709. **Vaurie, C.** A Revision of the Bird Family Dicruridæ. *Bull. Amer. Mus. Nat. Hist.*, 93, art. 3, issued May 23, 1949, 199–342, tfs. 1–14, tab. 1–12.

15710. **Vervoort, W.** Exotic Hydroids in the Collections of the Rijksmuseum Van Natuurlijke Historie and the Zoological Museum at Amsterdam. *Zool. Meded.*, Leiden, xxvi, 1946, 289–351, tfs. 1–10.

15711. **Webber, L. C.** The Ground Parrot in Habitat and Captivity. *Pezoporus wallicus*. *Avicult. Mag.*, liv (2), March-April, 1948, 41–45, pl.

15712. **Webster, H. O.** Field Notes on *Malurus elegans*, the Red-winged Wren of Western Australia. *Emu*, xlvii (4), March, 1948, 287–290, pls. 19–20.

15713. **White, S. R.** The Breeding of Crimson Chats in the Morawa District in 1949. *W. Aust. Nat.*, ii (3), Jan. 24, 1950, 49–54, col. pl.—*Ephthianura tricolor*.

15714. **Whitley, G. P.** The Handfish. *Aust. Mus. Mag.*, ix (12), July-Sept. (Sept. 30=Dec. 2, 1949), 398–403, illustr.—Deals with the fishes of the family Brachionichthyidæ and describes and figures the three species recorded from Australian waters. Notes on evolution.

15715. **Whitley, G. P.** Studies in Ichthyology. No. 14. *Rec. Aust. Mus.*, xxii (3), Jan. 27, 1950, 234–245, tfs. 1–5, pl. xvii.—*Odontaspis herbsti* sp.n. Three miles north of Gabo Is., N.S.W. *Pisodonophis cancrivorus* (Richardson), holotype figured, Darwin, N.T. *Yozia compitalis* sp.n. Pyrmont, Sydney. *Histiogamphelus briggsii oræ* subsp.n. Thompson's Bay, Coogee, N.S.W. *Quiris* g.n. Orthotype, *Q. stramineus* sp.n. Katherine River, N.T. *Scævius milii* (Bory). Shark's Bay, W.A. *Pomadasys (Pristipomus) auritus* (Cuv. and Val.). Newcastle Harbour, N.S.W. *Toxotes dorsalis* sp.n. Flinders River, near Hughenden and Richmond, Q. *T. ulysses* sp.n. Townsville, Q. *Protoxotes* g.n. Orthotype, *P. lorentzi* (Weber). Yam Ck., N.T. (New record.)

15716. **Whitley, G. P.** Fauna. Mammals. *Australian Fisheries*, 1950, pp. 42–44.

15717. **Whitley, G. P.** Development of a Port Jackson Shark. *Proc. R. Zool. Soc. N.S.W.*, 1948–49 (May, 1950), 28.—*Molochophrys galeatus* (Gunther), Crested Port Jackson Shark.

15718. **Whitley, G. P.** Some Rare Australian Fishes. *Proc. R. Zool. Soc. N.S.W.*, 1948–49 (May, 1950), 32–34, tfs. 1–5.—Flounder, *Arnoglossus aspilos præteritus* subsp.n. W.A.: between Cape Jaubert and Wallal; N.T.: off Darwin. The Exquisite Goby, *Favonigobius exquisitus* sp.n. N.S.W.: Toukley and Narrabeen. Surgeon Fish, *Burobulla maculata* (Ogilby, 1887). N.S.W.: Lord Howe Is. Leather Jacket, *Tantalisor pauciradiatus* Whitley, 1947, W.A. Squirrel Fish, *Holotrachys major* spn. N.S.Wales.

15719. **Whitley, G. P.** New Fish Names. *Proc. R. Zool. Soc. N.S.W.*, 1948–49 (May, 1950), 44.—Nineteen new generic names are proposed for preoccupied names listed in Neave's *Nomenclator Zoologicus*.

15720. **Whitley, G. P.** Butterfly Cod. *Aust. Mus. Mag.*, x (2), March 31 (=4 July, 1950), 41–46, illustr.—Popular account. Scorpænidæ:

Butterfly Cod, *Pterois volitans*; *P.* (*Macrochirus*) *miles*, the Saw-cheeked Lionfish; *P. radiatus* from Rarotonga. The Fan Dancer or Dwarf Lionfish, *Brachirus zebra*; Turkey Fish, *B. koenigii*, from Honolulu. The others are known from Australia.

15721. **Whitley, G. P.** A New Shark from North-Western Australia. *W. Aust. Nat.*, ii (5), July 7, 1950, 100–105, tfs. 1–2.—A new variety of whaler shark, here called Tilston's Shark, *Galeolamna pleurotænis tilstoni*, is described and figured. It was captured at the Van Cloon Reef, Joseph Bonaparte Gulf, W.A., and named in honour of Assistant Surgeon Tilston, naturalist at the old-time settlement of Port Essington, N.T.

15722. **Wood, E. J. Ferguson.** Investigations on Underwater Fouling. I. The Role of Bacteria in the Early Stages of Fouling. *Aust. J. Marine and Freshwater Res.*, Melbourne, i (1), April, 1950, 85–91.—The author here commences an investigation of the biological factors involved in under-water fouling. It is shown that algal spores, diatoms and, to a smaller extent, bacteria, are concerned in initiating primary organic film formation on glass slides immersed in the sea at stations on the coast of N.S.W. near Sydney.

15723. **Wood Jones, F.** The Study of a Generalized Marsupial (*Dasycercus cristicauda* Krefft). *Trans. Zool. Soc. Lond.*, xxvi (5), Nov., 1949, 409–501, pls. i-ii, tfs. 1–99.—Deals with the taxonomy and external characters, habits, life-history and ecology, as well as the osteology and anatomical features.

PALÆONTOLOGY.

Hon. Abstractor: H. O. Fletcher.

15724. **Cotton, Bernard C.** Pleistocene Land and Freshwater Shells from South Australia. *Rec. South Austr. Mus.*, ix (3), 1950, 352.

15725. **Crespin, Irene.** Australian Tertiary Microfaunas and their Relationships to Assemblages Elsewhere in the Pacific Region. *J. Pal.*, xxiv (4), 1950, 421–429.—Marine Tertiary rocks in Australia are confined chiefly to narrow strips along the western and southern coasts of the mainland and the north coast of Tasmania. Differences in sedimentation and foraminiferal assemblages suggest that they were laid down in two major sedimentary provinces here designated the Austral-Indo-Pacific province and the Bass Strait province. The foraminiferal assemblages in each province are discussed and correlations with other areas in the Indo-Pacific region and New Zealand are suggested.

15726. **Lawson, Paul H.** A Reconstruction of the Kangaroo Island Emu (*Dromaius diemenianus*). *Rec. South Austr. Mus.*, ix (3), 1950, 309–312.

15727. **Maxwell, W. G. H.** An Upper Devonian Brachiopod (*Cyrtospirifer reidi* sp. nov.). *Univ. of Q'land Papers*, iii (12), 1950, 3–8.—A species of the genus *Cyrtospirifer*, collected from beds in the south-south-west of the Mount Morgan district, is described and named, and the age of the beds is determined as Upper Devonian.

15728. **Stubblefield, C. J.** *Dimastocephalus* Stubblefield, 1950, a Synonym of *Carolinites* Kobayashi, 1940. *Ann. Mag. Nat. Hist.*, iii (29), Ser. 12, 1950, 451–452.—The new genus *Dimastocephalus* described from the early Ordovician of Co. Galway, Eire, is now recognized as a synonym of the genus *Carolinites* described from Lower Ordovician rocks at Caroline Creek, northern Tasmania.

15729. **Wright, C. W.** Comment on Proposal to Substitute Prosopon for Ornament. *J. Pal.*, xxiv (4), 1950, 497.

GEOLOGY.

Hon. Abstractor: R. O. Chalmers.

15730. **Andrews, P. B.** A Contribution to the Stratigraphy and Physiography of the Gloucester District. *Proc. Roy. Soc. N.S.W.*, lxxxiii, 1, 1949, 1–7.—New aspects of the stratigraphy and physiography of the Gloucester-Stratford district are presented. The important Carboniferous sequence of the western side of the Stroud-Gloucester trough is not found on the eastern side.

15731. **Bannister, F. A., and Horne, J. E. T.** A Radio-active Mineral from Mozambique Related to Davidite. *Min. Mag.*, xxix, 1950, 101–112.—In 1947 this black, opaque, radio-active mineral was discovered. Rough crystals have been found sometimes of considerable size (one crystal fragment weighed 22 pounds) and it is trigonal. Although davidite from Olary, South Australia, does not resemble it crystallographically, it corresponds very closely in chemical, physical and optical properties. A complete analysis has been carried out on carefully selected material and a provisional formula derived. Specimens from both localities are metamict, but X-ray investigation shows that they can be recrystallized by powdering and then heating to a high temperature for several hours. A re-examination of sefstromite, a supposed vanadiferous variety of ilmenite occurring with davidite at Olary, South Australia, shows it to be a mixture of one or more metamict minerals, not, however, davidite itself, with rutile and ilmenite.

15732. **Browne, W. R.** Metallogenetic Epochs and Ore Regions in the Commonwealth of Australia. *Proc. Roy. Soc. N.S.W.*, lxxxiii, 2, 1949, 96–113.—In this, the Clarke Memorial Lecture given to the Royal Society of New South Wales, the author deals with the metallogenetic epochs of the Commonwealth, chiefly those connected with plutonic intrusions together with the principal ore deposits thought to belong to them. Attention is drawn to some curious features in the time- as well as the space-distribution of the ores. The gradual eastward migration of the loci of primary ore deposition from Middle Palæozoic to the close of Mesozoic time is shown.

15733. **Browne, W. R.** Some Thoughts on the Division of the Geological Record in the Commonwealth of Australia. Presidential Address, Section C—Geology. *Aust. and N.Z. Assoc. Adv. Sci.*, xxvii, Hobart, 1949, 35–46.—The chief tectonic epochs in the Australian record are dealt with and correlated with extra-Australian epochs. The stratigraphic record is given in light of the latest knowledge and particular attention is paid to those boundaries of our major stratigraphical divisions that are in dispute, particularly that between the Carboniferous and the Permian.

15734. **Bryan, W. H.** The Geological Approach to the Study of Soils. Presidential Address, Section C—Geology. *Aust. and N.Z. Assoc. Adv. Sci.*, Adelaide, xxv, 1946, 52–70.—Study of soils should form part of our geological discipline. A knowledge of pedology gives to the geologist an additional and important field method of geological mapping and a powerful aid in the unravelling of many geological problems, particularly those of palæoclimatology and geomorphology.

15735. **Crohn, P. W.** The Geology, Petrology and Physiography of the Omeo District, North-Eastern Victoria. *Proc. Roy. Soc. Vict.*, lxii, 1, 1950, 1–70.—The bed-rock of the area consists of schists and gneisses forming part of the metamorphic belt of north-eastern Victoria. Increase in metamorphic grade is noted as gneissic intrusions are approached. Younger sediments of Devonian age occur, and in late Devonian time there occurred intrusions of granite, diorite and basic types. Tertiary basalts and phonolites are recorded and the known mineral resources of the area are classified.

15736. **Edwards, A. B.** The Petrology of the Cainozoic Basaltic Rocks of Tasmania. *Proc. Roy. Soc. Vict.*, lxii, 1, 1950, 97–120.—More than 300 specimens collected on traverses of the major and minor basaltic areas in Tasmania have been examined and classified. The detailed petrology is described and 11 new analyses presented. It appears, on petrological grounds alone, that in Tasmania either there were, as in Victoria, two major periods of volcanicity or else that contemporaneous extrusions developed from two or more coexistent basaltic magmas. The second alternative is favoured.

15737. **Fairbridge, R. W.** Notes on the Geomorphology of the Pelsart Group of the Houtman's Abrolhos Islands. *J. Roy. Soc. W.A.*, xxxiii, 1946–7, 1–43.

15738. **Fairbridge, R. W.** The Geology and Geomorphology of Point Peron, Western Australia. *J. Roy. Soc. W.A.*, xxxiv, 1947–8, 35–72.—The area described is made up entirely of Pleistocene and Recent sediments, the oldest rock type being the Pleistocene calcareous eolianite, the Coastal Limestone. The present limestone shore is bevelled by broad marine platforms forming at low water level today.

15739. **Fairbridge, R. W., and Teichert, C.** The Low Isles of the Great Barrier Reef: A New Analysis. *Geog. J.*, cxi, 1–3, 1948, 67–88.—The physiography of Low Isles has been systematically compared with a span of 17 years, 1928-1945. The shape has been maintained, the growth rate being almost unnoticeably slow. The development and disposition of ramparts and the factors controlling them are discussed.

15740. **Fairbridge, R. W.** Recent Advances in Eustatic Research. Report of Committee for Investigation and Correlation of Eustatic Changes in Sea-Level. *Aust. and N.Z. Assoc. Adv. Sci.*, xxvii, Hobart, 1949, 181–184.—An account is given of recent research on the subject in Australia and adjacent regions and overseas also.

15741. Geological Reports, 1939–1945. Geological Survey, Mines Department, N.S.W.—These are the reports that normally would have appeared each year in the Annual Reports of the Mines Department. These Annual Reports have not yet been published, and the geological reports have been brought out as a single volume. They comprise reports on mineral deposits, coal resources, selection of dam sites, blue metal quarries and water resources.

15742. **Gill, E. D.** Geology of Picnic Point, Port Phillip Bay, Victoria. *Proc. Roy. Soc. Vict.*, lxii, 1, 1950, 121–127.—Evidence for an emerged shore platform and an emerged shell bed or emerged beach at Picnic Point is described. Lists of shells from the emerged beach deposits are given.

15743. **Hills, C. Loftus, and Carey, S. W** Geology and Mineral Industry Handbook for Tasmania. *Aust. and N.Z. Assoc. Adv. Sci.*, 1949, 21–44.—An account of the geological history and the economic geology of Tasmania is given.

15744. **Hills, E. S.** Tectonic Patterns in th Earth's Crust. Presidential Address, Section P—Geography and Oceanography. *Aust. and N.Z. Assoc. Adv. Sci.*, Perth, xxvi, 1947, 290–302.

15745. **Jutson, J. T.** On the Terminology and Classification of some Shore Platforms. *Proc. Roy. Soc. Vict.*, lxii, 1, 1950, 71–78.—The present terminology of the two main shore platforms (the high-level horizontal one or group, and the low-level sloping one) is criticized as incorrect or inadequate. A new terminology and classification of the various forms of platforms as at present known are suggested for consideration and discussion.

15746. **King, L.** The Cyclic Land-Surfaces of Australia. A Geomorphological Summary. *Proc. Roy. Soc. Vict.*, lxii, 1, 1950, 79–95.—The recent establishment of geological ages for the various cyclic land-surfaces of Africa, by the author, and the possibility that land-surfaces of comparable age and development might be found in other parts of the world, have prompted this enquiry into the landscape history of Australia.

15747. **Miles, K. R.** The Geology of the South Para Dam Project. *Geol. Sur. S.A.*, Bull. No. 24, 1950, pp. 66.—The dam site is 30 miles north-east of Adelaide. A description of the geology of the area is given, which is underlain partly by rocks of the older pre-Cambrian Barossa Series and partly by rocks of the Proterozoic Adelaide Series.

15748. **Noakes, L. C.** A Geological Reconnaissance of the Katherine-Darwin Region, Northern Territory, with Notes on the Mineral Deposits. *Bur. Min. Res. Bull. No.* 16, 1949, pp. 53.—The area covered by this geological reconnaissance is approximately 27,000 square miles north and west of Katherine. Sedimentary rocks consist of folded Lower Proterozoic sediments overlain by arenaceous Upper Proterozoic sediments and Lower Cambrian sandstones and limestones. The greater part of the region remained a land mass until freshwater sediments were deposited in late Jurassic or early Cretaceous time, followed by marine sediments of Lower Cretaceous age. Igneous rocks are of Lower Proterozoic age and include amphibolites and granites. The evolution of the topography is discussed.

15749. **Norrish, K.** An X-ray Study of West Australian Beryl. *J. Roy. Soc. W.A.*, xxxiv, 1947–8, 1–16.—The Laue, the single crystal rotation and the powder methods of X-ray analysis were used to study a crystal of Western Australian beryl. The results obtained are in agreement with the other published data on beryl.

15750. **Raggatt, H. G.** Depletion of Mineral Resources—A Challenge to Geology and Geophysics. Presidential Address, Section C—Geology. *Aust. and N.Z. Assoc. Adv. Sci.*, Perth, xxvi, 1947, 109–133.

15751. **Raggatt, H. G.** Stratigraphic Nomenclature. *Aust. J. Sci.*, xii, 5, 1950, 170–173.—An Australian Code of Stratigraphic Nomenclature is published. This has been drawn up by the Standing Committee on Stratigraphic Nomenclature set up at the Perth (1947) meeting of the Australian and New Zealand Association for the Advancement of Science.

15752. Reports from Committees of Section C—Geology. *Aust. and N.Z. Assoc. Adv. Sci.*, Adelaide, xxv, 1946, 345–387.—These reports are particularly comprehensive, since they cover the entire period since the A.N.Z.A.A.S. meeting at Canberra in 1939. Reports were furnished by the Glacial Phenomena Committee, the Committee on Correlation of Late Palæozoic Rocks in Australia, the Metamorphism and Assimilation Committee, Correlation of Tertiary Rocks of Australia and New Zealand Committee and the Committee for Research on Igneous Rocks.

15753. Report from Section P—Geography and Oceanography. Structural and Land Forms of Australia and New Zealand. *Aust. and N.Z. Assoc. Adv. Sci.*, Adelaide, xxv, 1946, 395–420. .

15754. **Terrill, S. E.** Notes on Laterite in the Darling Range near Perth, Western Australia. *J. Roy. Soc. W.A.*, xxxiv, 1947–8, 105–113.—The parent rock is quartz dolerite and the fact that the laterite has developed virtually without disturbance of the alumina-ferric oxide ratio is taken as affording evidence of a process of elimination of other constituents by solution.

15755. **Walkom, A. B.** Gondwanaland: A Problem of Palæogeography. Presidential Address. *Aust. and N.Z., Assoc. Adv. Sci.*, xxvii, Hobart, 1949, 1–13.—An account was given of four hypotheses put forward to explain the distribution of continental land masses in Upper Palæozoic time, and it seems that the most acceptable is that postulating continental lands much as today but joined latitudinally from time to time by isthmian inks.

PALÆONTOLOGY.

Hon. Abstractor: H. O. Fletcher.

15756. **Crespin, Irene.** Some Tertiary Pelecypoda from the Lakes Entrance Oil Shaft, Gippsland, Victoria. *Roy. Soc. Vict.*, lx (n.s.), 1950, 149–156.—Four new species and six well-known but rarely figured species of pelecypoda are described from the Kalimnan, Balcombian and Janjukian deposits in the Lakes Entrance shaft.

15757. **Gill, Edmund.** A Study of the Palæozoic Genus *Hercynella* with Description of Three Species from the Yeringian (Lower Devonian) of Victoria. *Roy. Soc. Vict.*, lix (2) (n.s.), 1950, 80–92.—*Hercynella* is a primitive gastropod which has previously been classified as a pulmonate. Evidence is put forward which suggests that it is a normal marine gastropod and not a pulmonate. This evidence deals with its analogies with other fossil forms, its ecology, and the palæontological history of pulmonates. Three species, including two new ones, are described.

15758. **Gill, Edmund.** The Biological Significance of Exoskeletal Structures in the Palæozoic Brachiopod Genus *Chonetes*. *Proc. Roy. Soc. Vict.*, lx (n.s.), 1950, 45–56.—An attempt is made to interpret the functions of the various exoskeletal structures in *Chonetes* by a study of their form, their relationship to other structures, and their homologues in extinct brachiopods. Attention has been paid especially to the spines on the ventral valve, which are characteristic of the genus. Something of their ecology is inferred from their fossil occurrence. Finally, an attempt is made to estimate the phylogenetic significance of the facts and interpretations in this study.

15759. **Gill, Edmund.** Palæontology and Palæoecology of Eldon Group. *Papers and Proc. Roy. Soc. Tas.*, 1949, 232–258.

15760. **Gill, Edmund.** Fossil Plants in Basalt at Maribyrnong, Victoria. *Vict. Nat.*, lxvii, 1950, 123–129.

15761. **Gill, Edmund, and Baker, Alfred A.** Fossil Plants in Basalt at Maribyrnong, Victoria. *Vict. Naturalist*, lxvii, Oct., 1950, 123–129.—The age of the plants and basalts is probably either lower or (at latest) middle Pleistocene.

need for maps and to satisfy that requirement to the limit of our potential and economy. It requires a sound anticipation related to areas, types and timing, and an appreciation of the user's interest.

Basic topographical mapping is a public service, and as such should be a function of government; implemented not exclusively by any one department, but conceivably by many agencies, including the commercial mapping companies under contract. It is a form of insurance against bad development and as it pays handsome and immediate dividends, should be entitled to its share of budgetary provisions. The map user could now rightly expect service and the quality and extent of that service will depend primarily with the efficacy of organization.

Research Notes

Alkaloid Production in Plants and its Significance to Pharmacology and Agriculture

(*Communication to the Medical Sciences Club of South Australia, December 1950.*)

B. Horowitz

Species containing alkaloids are widely distributed throughout the plant world. Though related genera contain a similar type of alkaloids, the same alkaloid was found in quite unrelated families. While resting mature seed of Solanaceae contains no alkaloid, the latter appears at a very early stage of germination, increasing rapidly throughout the growing period, reaching its maximum about flowering time and decreasing slightly afterwards. The decreasing order of nicotine content in various parts of a plant is: leaf mesophyll, lateral roots, inflorescences, stalks and main roots. The xylem portion of the stalk contains more nicotine than the phloem, as through the former passes the upward movement of the alkaloid.

The location of the organs in which alkaloids were formed was determined by the approach graft technique in which an alkaloid-producing plant and a non-alkaloidal one were combined in a graft, both scion or stock. This method, and also similar grafts between plants producing various alkaloids, have shown that the root is the organ in which alkaloids of a large number of Solanaceae are formed. The transpiration stream is the agency transporting the alkaloids from the roots through the xylem portion of the stalks to the leaves. Only anabasine of *Nicotiana glauca* is produced both in the roots and the leaves, and nor-nicotine of some Nicotianas is formed in the leaves only as a secondary product from the nicotine of the roots by means of a trans-methylation process. Feeding experiments on detached organs have shown that some amino-acids or sulphate of ammonia with sucrose act as precursors of certain alkaloids.

Production of a high or low alkaloid content is determined by the variability and inheritance of this character. Of the environmental factors which increase the alkaloid content and yield, the following are discussed:

- arid or semi-arid climatic conditions with a moderate moisture supply;
- a heavy type of soil;
- nitrogenous nutrients in excesses and cultural methods like topping and desuckering.

An interspecific variability of the alkaloid content allows selection not only of the type with the highest or lowest alkaloid content, but also with predominance of a given alkaloid or with the most desired ratio of the various alkaloids. Inter-varietal and inter-specific hybrids enable us also to incorporate some valuable agronomic characters in the cross. As inter-specific hybrids are often sterile, artificial induction of polyploidy, preferably by the colchicine technique, is used. While in *Duboisia* spp. vegetative propagation permits a quick establishment, of an improved clone, this is a more lengthy procedure in generatively propagated Solanaceae like *Nicotiana* spp. In addition to producing for high alkaloid content and yield some aspects of producing for a decreased alkaloid content are illustrated in the production of a biological denicotinized tobacco, 'sweet' lupin, free of alkaloids and on *Ricinus*. The possibility of introducing a number of 'poisonous' plants into cultivation for human or animal consumption as a result of decreasing the amount of their 'poisonous' element is being investigated.

Development of the Resources of Coral Atolls

The South Pacific Commission has engaged Dr. L. R. Catala to carry out its project for improvement of resources on coral atolls. Dr. Catala has been released by the Institut Français d'Oceanie (Noumea) for six months for this work. He will be assisted by his wife. Their investigations will include a survey of the physical environment in the Gilbert and Ellice Islands, with a view to discovering ways of increasing the quantity and variety of subsistence and commercial crops, improving domestic animals and exploiting fisheries and native handicrafts. The results are expected to be of great value for islands of this type both in this Colony and elsewhere in the South Pacific.

In the South Pacific area the majority of the indigenous peoples are found on the larger islands, but the problems of economic development are most acute with the dwellers on coral atolls and the low islands. The Gilbert and Ellice Colony is comprised wholly of these low islands; but atolls and low islands are found in several territories of the region, especially in French Oceania, the Cook Islands, the Tuamotu Group, the Union Group, some of the Fiji Group,

and others. The low islands are not so well off as the others for experimental accomplishments, resources and trained personnel; and although they may receive the benefit of sporadic investigations, sustained studies devoted to coral island production problems have been seldom undertaken.

The low-lying coral islands have as a rule a small area of arable land, little variety of soil and weather; and consequently the peoples' means of livelihood are severely limited and handicapped. There are no pastures or cattle; a few pigs and chickens may constitute the livestock. The coconut palm is the principal tree on the islands. There are a few other kinds of trees useful for local needs. Often the human carrying capacity of an island has been reached. In these cases it becomes necessary to settle the surplus population elsewhere. Copra has been the principal cash crop, and mats made from pandanus leaf fibre a second source of income.

On most of these islands the soils are thin and deficient in essential minerals. They seldom support coconut palms in full health and vigour. Yet there is in sight no plant which in any way promises to be a suitable substitute, or better able to endure the conditions. According to the capacity of the soils, food plants consist of taro, breadfruit, yams, arrowroot and Polynesian chestnut, and the introduced sweet potato, banana and some citrus, as well as pineapple. The lagoon and reefs supply fish and crustaceans. Pearl and trochus shells have a market with the button makers, but the good shells do not always grow in local waters.

The peoples of the low islands of the South Pacific are those most in need of help in the way of increased variety and amount of production. Improvement will not be rapid, because they cannot sacrifice present production for new or changing agriculture on a scale which would disrupt their present system and economy.

The Commission's investigation will include such matters as:

(a) A programme of coconut palm improvement designed to increase yields and resistance to pests and diseases.

(b) A food plant programme including studies of the physiology of the breadfruit tree; the development of wet-land taro; the introduction of bananas suitable to the area; the production of other foodstuffs, especially those requiring additional fertility such as sweet potato, vegetables and citrus fruits; the supplementary nutrition of swine; the improvement of poultry in egg-laying capacity, time and weight development and freedom from disease.

(c) The collection of information with a view to developing shell fisheries by planting trochus and pearl shell, and assessing the possibilities of silk-grade sponges.

(d) A survey of handicrafts with a view to their development as a means of improving the peoples' material conditions of life and as a source of export income.

Obituary

Andrew Gibb Maitland

ANDREW GIBB MAITLAND, the last of the pioneer Australian geologists, died in Perth, Western Australia, on 27 January 1951. His death came after many years of retirement, during which failing health prevented him from carrying out some projects set aside for his years of leisure—unfortunately there is no one with his rich and varied experience and considerable literary gifts left to complete them.

Maitland was born in Huddersfield on 30 November 1864, and was a student and prizeman of Yorkshire College, Leeds, later the University of Leeds, where he was trained in geology by A. H. Green, W. W. Watts, and J. E. Marr. After some experience in geological field-work in England, he was, at the age of twenty-four, appointed Assistant Geologist to the Geological Survey of Queensland. On this survey he spent eight years; except for a part of 1891 when he was seconded to British New Guinea, of which he made the first approach to a systematic geological survey.

From 1896 to 1926 Maitland was Government Geologist and Director of the Geological Survey of Western Australia. His services to science during this period of thirty years comprised both original and administrative work. Investigation of the water resources of the State and of the Pre-Cambrian of the 'North-West' were his most notable achievements in the way of original work. Soon after his appointment, he concentrated on the water-supply problem in a coastal strip extending from North-West Cape southwards for nearly three hundred miles. This strip had some promise as a pastoral area but for its insufficient water. Maitland studied its geological structure, which he found was favourable to the occurrence of artesian water. On his advice, the Government bored near Carnarvon to 3011 feet, and obtained a flow of a little over half a million gallons per day. Many bores, yielding a plentiful supply of good stock water, have since been put down in this 'North-West Basin'. Sir Edgeworth David in 1932 referred to this development as 'the greatest economic discovery as yet accredited to any Australian geologist'. Further field work led Maitland to predict that artesian

water would be found near Derby in the Kimberley, and in the Nullarbor Plain. These predictions have been verified. On the other hand, after a careful examination of many districts in the eastern goldfields and in what is now the wheat belt, he stated that artesian water did not occur in any part of them. In defiance of his strongly expressed advice, a bore was put down at Coolgardie to 3002 feet, through granitic rocks, and proved fruitless.

Maitland's second great original achievement was the geological survey of the Pilbara goldfield. Field work from 1903 to 1906—under conditions which it is rather hard to picture in these days of motor car, aeroplane and wireless—enabled him to present, in Bulletins No. 15, 20, 23 and 40 of the Geological Survey of Western Australia, a broad account of the geology of an area of 30,000 square miles, and details of all its active or defunct mining centres. Maitland divided the Pre-Cambrian Pilbara rocks into a distinct 'series' of various ages. His classification, which seems to have been substantially verified by later geologists, has been very useful in attempting to clear up the even more obscure succession in the southern goldfields of the State.

On the administrative side, also, his achievements were considerable. From his earliest days in Western Australia, Maitland worked, as continuously as long periods of isolation in the field allowed, at the organization and enlargement of the Geological Survey Branch of the Mines Department. Throughout his long tenure of office, he steadfastly maintained that the chief function of a Geological Survey must be to arrive as soon as possible at a broad knowledge of the geology of the whole area assigned to it, this knowledge to be continually amplified and corrected by more detailed work. He was quite aware of the value of detailed local geological knowledge to mining and other industries, but he always insisted that this close survey should be combined with broad mapping of the surrounding country. Maitland persisted in this wise policy in spite of sometimes vociferous criticism both in Parliament and in the Press—criticism which must have been very trying to one of his shy and retiring nature. In 1919 he epitomized the researches of the Geological Survey and of others in his *Summary of the Geology of Western Australia*, accompanied by a geological map of the whole State, in which only the most inaccessible parts were left blank.

Maitland always stressed the value of a full recording, both on maps, in notes, and by well-indexed specimens, of all geological observations—whether published or not—so that those who came after might use, and not repeat, the work of predecessors. His quiet influence has undoubtedly impressed itself on later geological workers in Western Australia.

He was an original member of the Mueller Botanic Society and of the Natural History and Science Society which succeeded it, and was a prime mover in the conversion of the latter into the Royal Society of Western Australia, of which he was twice President, besides being for very many years a member of its Council. He was also for more than twenty-five years Local Honorary Secretary of the Australian and New Zealand Association for the Advancement of Science. He was awarded the von Mueller Medal by the Australian and New Zealand Association for the Advancement of Science, the Clarke Memorial Medal by the Royal Society of New South Wales, and the Kelvin Medal by the Royal Society of Western Australia. These honours were indeed well-earned tributes to the man and his work.

E. DE C. CLARKE.

News

Visits by Overseas Scientists

THE Brisbane meeting of A.N.Z.A.A.S. will be outstanding for the number of distinguished scientists from overseas who will be taking part in the discussions. Two groups of visitors will be coming. The first group will lead the UNESCO-sponsored symposium on 'Genetics and Evolution'. It will comprise Professor Waddington from Glasgow, now specializing in Animal Breeding; Dr. Ford from Oxford, well known for his work on microspecies of Butterflies; Professor Sirks, Rector of the University of Gröningen, Holland, a noted plant geneticist; Professor Rensch from Frankfurt, who has specialized on the study of the evolution of species groups; Dr. Gaylord Simpson from New York, who will be discussing modern views on the evolution of the horse; and Professor Dobzhansky from Columbia, U.S.A., who is known not only for his work on Drosophila genetics but also for his contributions to general problems of evolution.

The second group of visitors is being invited in connexion with the Commonwealth Government Jubilee Celebrations and will represent the different Commonwealth countries. Professor Adrien, President of the Royal Society, is coming from Great Britain; Dr. Malherbe from South Africa; Dr. Howlett from Canada; Dr. Ahmad from Lahore, Pakistan; and Dr. Archy from New Zealand. It is hoped that a representative from India will also be present. These visitors will greatly strengthen discussions in their respective fields of Physiology, Education, Physics, Chemistry and Zoology.

'Archives of Biochemistry and Biophysics'

In view of the increasing use of physical methods in problems of biochemistry, especially in borderline fields, the scope of the journal, *Archives of Biochemistry*, is to be widened to include the fields of virus research, radiation

effects on living matter, macromolecular biology and chemistry, studies of the application of radioactive indicators, and physics of biological systems.

Beginning with Volume XXXI, March 1951, the title of *Archives of Biochemistry* will be changed to *Archives of Biochemistry and Biophysics*. The Editorial Board has been enlarged by the appointment of E. Newton Harvey, E. C. Pollard, and R. W. G. Wyckoff.

British Instrument Industries' Exhibition

The first exhibition to be devoted exclusively to the British Instrument Industry is to be held at the National Hall, Olympia, London, from 4 to 14 July 1951. Over 150 manufacturers will be displaying products of entirely British manufacture. Information, and copies of the Catalogue, may be obtained from the organizers, F. W. Bridges and Sons Ltd., Trafalgar Square, London, W.C.2, who will also make arrangements for intending visitors from overseas.

Congress of Entomology

The IX International Congress of Entomology will be held at Amsterdam from 17 to 24 August 1951. Its general meetings will be at the Indisch Institute. Sections will include: Systematics and Morphology; Nomenclature; Genetics and Ontogeny; Physiology; Ethnology (analytical behaviour studies); Ecology and Biology; Zoogeography; Agricultural Entomology and Beekeeping; Forest Entomology; Tropical Agricultural Entomology; Stored-products Entomology; Medical and Veterinary Entomology; Insecticides and Insecticidal Technique; Arachanoidea. Symposia will be organized in several Sections.

Communications should be sent to the Hon. Gen. Secretary, 136 Rapenburgerstraat, Amsterdam.

World Health Organization

The W.H.O., which already has regional organizations in the Eastern Mediterranean area, South-east Asia, and the Americas, as well as a special office in Europe, is now preparing for the creation of a new regional organization for the Western Pacific area. The region provisionally includes Australia, China, the Philippines, South Korea, New Zealand, Viet Nam, Laos, Cambodia, Japan, Malaya and Singapore. This region comprises over 600-million people. Work already done by W.H.O. in the region is in fields ranging from campaigns against malaria, tuberculosis, and venereal diseases to the training of nurses and surgeons.

Fisheries Research Publications

The Fisheries Research Board of Canada is revising and extending the distribution list of its publications. Those currently being issued include the Journal, Bulletins, Progress Reports and Annual Report. For the most part these are devoted to presenting the results of investigations carried out by or sponsored by the Board at its four biological stations and three experimental stations. Investigations at the biological stations lie in the fields of fishery biology, physical and biological oceanography and limnology, and occasionally also the morphology, taxonomy and distribution of fishes and other aquatic organisms, both marine and freshwater. The work of the experimental stations includes all aspects of the technology of preserving and marketing fish and fishery products, studies of their chemical composition and nutritive value, and basic biochemical and bacteriological problems that are of interest in these fields.

The Board would be pleased to send its publications regularly to any organization which maintains a permanent library and would be interested in receiving them. It would also welcome exchange publications containing reports of investigations in any of the fields mentioned above, or in allied branches of zoology, chemistry and so on. Communications should be sent to the Editor, Fisheries Research Board of Canada, Pacific Biological Station, Nanaimo, B.C., Canada.

Indo-Pacific Fisheries Council

The Indo-Pacific Fisheries Council has just completed its third annual meeting at Madras, India. The meeting took place from 1 to 16 February, during which time, in addition to the full sessions of the Council and to meetings of technical committees and sub-committees, the Council attended various excursions to places of fishery interest in the State of Madras. The meeting was attended by representatives of the Governments of Australia, Cambodia, Ceylon, France, India, Indonesia, Netherlands, Pakistan, Philippines, Thailand, United Kingdom, U.S.A., and Viet Nam. The following international organizations were represented by observers: F.A.O., P.S.C., S.C.A.P., S.P.C., U.N.E.S.C.O.

The Council made various amendments to its Rules of Procedure in order to bring these more into conformity with the plan of operation desired by delegations. The Council laid down a detailed plan of work in connexion with the preparation of fishery bibliographies and a plan in connexion with the preparation of a series of fishery handbooks. Recommendations were made for action to secure the widest possible dissemination, within the region, of information concerning fishery matters and also for the use of documentary films on fishery subjects. The Council paid particular attention to the problem of providing trained personnel for the fishing industries of the region and adopted a plan for the development of projects for technical instruction.

The Council's Technical Committees considered all technical aspects of fishery resources, fishing industries, and official and semi-official

programmes in relation with these; and on the advice of the Technical Committees the Council has made numerous recommendations to member governments for the development of programmes in Hydrology, Planktology, Fisheries Biology, Fishery Gear Technology, Fishery Food Technology and Socio-economics. In sum, the Council can claim to have achieved in this meeting a vantage point from which to view the fishing industries of the region and the programmes in relation to them. The fact that the Council has made specific recommendations for action in respect of particular problems indicates that it has now passed through its formative stages.

National University

Professor J. C. Jaeger, who at present occupies the Chair of Applied Mathematics in the University of Tasmania, has been appointed Professor of Geophysics in the Research School of Physical Sciences. He is to take up duty in Canberra early in 1952. Professor Jaeger is forty-three years of age; he graduated from the University of Sydney with the Medals for Mathematics and Physics and proceeded to Cambridge, where in 1930 he took the Mayhew Prize for Applied Mathematics in the Tripos. For the next five years he was engaged in research at Cambridge under R. H. Fowler. He is a Doctor of Science of the University of Sydney.

The Hon. Michael Lindsay has been appointed as Senior Research Fellow in the Research School of Pacific Studies. He is a Master of Arts of Oxford, his special subject of study there being Economics. After a period of post-graduate study at Trinity College, Cambridge, he undertook work connected with an industrial survey of South Wales, and then went to Yenching University, Peking, where he organized a course in Philosophy, Politics and Economics. He spent the academic year 1946-1947 as a visiting lecturer at Harvard. Since 1948 he has been Lecturer in Economics at University College, Hull. Mr. Lindsay is the eldest son of Lord Lindsay of Birker, who was Master of Balliol College, Oxford, from 1924 to 1949.

University of Melbourne

The Chair of Obstetrics and Gynaecology, which has been vacant since the death of Professor Marshall Allan in 1946, has been filled by the appointment of Sidney Lance Townsend, a graduate of Melbourne who undertook post-graduate study in London and had war service with the Royal Navy. He returned to Australia at the end of 1947 to commence practice and has been Demonstrator in Anatomy at the University. He is thirty-eight years of age.

Other appointments include Anita Rosenberg as lecturer in French and German to Science students; J. F. G. Darby as lecturer in Physics; Margaret Blackwood as lecturer in Botany; T. O'Dennell as lecturer in Chemistry; Patricia Keogh as lecturer in Physiology. Promotions to the rank of senior lecturer include A. A. Wilcock in Geography and A. S. Buchanan in Chemistry. W. Boardman (senior lecturer in Zoology) has been granted study leave for 1951. G. A. Ampt (lecturer in Chemistry) has been granted extended sick leave.

The Beaney Scholarship in Pathology has been awarded to J. Hueston, aged 25, who is Associate Surgeon to Julian Smith at the Royal Melbourne Hospital. The Sir John and Lady Higgins Scholarship has been awarded to D. J. Swaine for the study of the distribution of trace elements in soils. Mr. Swaine, formerly senior demonstrator in Analytical Chemistry, is abroad on two years leave of absence and is at present at the Macaulay Institute, Aberdeen.

N.S.W. University of Technology

Construction of the first main building, at a contract price of £690,000, has now commenced at Kensington. The building is to be three storeys high, and will contain lecture rooms and laboratories for teaching Physics, Chemistry, Mathematics, Mathematical Drawing and Design, Geology, and Mining Engineering. It will also include administrative offices, a lecture theatre accommodating 200, and a dining hall.

Professor R. N. Hartwell, who was appointed to fill the Chair of Economic History (in the Faculty of Humanities), and who has been studying abroad as a Research Fellow of the National University, has now taken up his duties.

The Societies

Royal Society of Victoria

December: E. D. Gill. Further studies in Victorian Chonetidae (Palaeozoic Brachiopoda).
W. Gentner (Professor of Physics in the University of Frieburg-im-Breisgau: lecture), Cloud chamber and photographic plate methods in the detection of elementary particles.
March: Conversazione and display of exhibits.

Institute of Physics, Australian Branch, N.S.W. Division

December: J. L. Pawsey, Problems of radio astronomy.
February: R. G. Wylie, Phase nucleation, with special reference to water.
March: V. D. Burgmann, Fibre physics and the work of the Wool Textile Engineering Laboratories.

Royal Society of Western Australia

December: B. C. Cotton, Sub-fossil molluscs between Esperance and Israelite Bay.
March: C. A. Gardner (lecture), Recent travels in Kimberley.
C. F. H. Jenkins (lecture), Some Kimberley insects.

Victorian Society of Pathology and Experimental Medicine

December: H. Barker, A. H. Ennor and K. Harcourt, The breakdown of phosphocreatine to creatine and phosphoric acid in the presence of traces of molybdenum.
A. J. Barnett, Some observations on the action of 'sympatheticolytic' drugs in man.

Lynne Reid, Some aspects of the pathology of human bronchiectasis.
W. Bate, The pathology of chronic pulmonary lesions following experimental influenza infection of mice.

March: M. Stewart (Professor, University of Leeds), Demonstration of allergic prostatitis in two cases of asthma, Demonstration of whole lung sections.
A. Gottschalk and G. Ada, The action of the influenza virus enzyme on its substrate.
A. Ferris, K. Semmens and E. V. Keogh, Cross infection in diphtheria wards.

Medical Sciences Club of South Australia

December: Films on Coramine; respiratory recordings; fertility.

Royal Society of New South Wales

December: J. R. Anderson, S. E. Livingstone and R. A. Plowman, Halogeno stannates (IV) of some complex cations.
S. E. Livingstone and R. A. Plowman, Palladium complexes, II. Bridged compounds of palladium with *o*-methylmercaptobenzoic acid.
F. P. Dwyer and J. W. Hogarth, The chemistry of osmium, VII. The bromo and chloro pentammine osmium-III series; VIII. A note on the preparation of ammonium hexachlorosmate-IV.
F. P. Dwyer and E. C. Gyarfas, The chemistry of iridium, V. The oxidation of iridium-III salt solutions.
L. E. Maley, Physical investigations on complexes of diphenylthiocarbazone.
F. R. Morrison, A. R. Penfold and Sir John Simonsen, The essential oils of *Zieria Smithii* Andrews, and its various forms, II.

Royal Society of Tasmania

March: L. W. Miller, Post-war development in pest control.

Royal Society of Queensland

April: M. F. Hickey (Presidential address), Form or function.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents.

Original Work

Phenols in Hair, with Particular Reference to Certain Marsupials

In previous communications it has been shown that the water extract of fur contains a considerable number of organic compounds. Some of these are present in unexpectedly large amounts, which vary greatly in different species. For example, rabbit fur contains approximately 400 mgm per cent. of uric acid and 400 mgm per cent. of glycogen (Bolliger and Hardy, 1945; Bolliger and McDonald, 1948; Bolliger, 1949).

The examination of the chemical constituents of fur has been extended to phenols mainly because the aqueous fur extract of some marsupials was found to give marked phenol reactions.

As usual the clipped fur was extracted with boiling water for about twenty minutes. This procedure was repeated four to five times. The frequently negligible steam-volatile phenols are lost if no reflux condenser is used in the extraction process. After removing the uric acid as silver urate (Volterra, 1942), the combined filtrates were examined for total phenols according to the method of Folin and Ciocalteu (1927). This reaction, though not very specific for phenols, gives useful indication of the relative phenol content of furs from different species.

TABLE I

Approximate amounts of total phenols in the aqueous extract of the fur of some eutheria.

	Total Phenols, mgm per cent.
Man	30
Cat	50
Sheep—Merino	25*
„ —Lincoln	35*
„ —Polworth	35*
„ —Corridale	55*
Guinea Pig	60
Rat	60
Rabbit	60

* Washed with ether and cold water before extraction with boiling water.

Table I indicates that in the fur of eutherian mammals examined the total phenols range from 25 to 60 mgm per cent. It is noteworthy that in the sheep the phenol content varies somewhat with the breed, the smallest values being obtained for merino, the highest for Corriedale fleeces.

TABLE II

Approximate amounts of total phenols in the aqueous extract of fur of some marsupials.

	Situation of fur	*Total Phenols, mgm per cent.*
Blackgloved wallaby (*Wallabia irma*)	Dorsum	170
Swamp wallaby (*Wallabia bicolor*)	„	130
Red kangaroo (*Megaleia rufa*)	„	120
„ „	Abdomen	210
Great-grey kangaroo (*Macropus major*)	Dorsum	120
Koala (*Phascolarctos cinereus*)	„	210
Ringtailed phalanger (*Psuedocheirus laniginosus*)	„	210
Common phalanger (*Trichosurus vulpecula*)	„	250
„ „	Abdomen	650
„ „	Sternum	720

Some herbivorous marsupials showed a total phenol content at least twice as high as that found in the eutheria examined so far: see Table II. Of these marsupials the most

intensive studies were made on the common phalanger or possum (*Trichosurus vulpecula*), the fur from different body regions being examined separately.

In a series of five phalangers it was found that the dark grey dorsal hairs contain on an average about 250 mgm per cent. (range 150-350 mgm per cent.) of total phenols. The white abdominal hairs range from 400 to 900 mgm per cent., averaging about 650 mgm per cent. The highest values, viz., 600 to 1000 mgm per cent., were encountered in the brown sternal hairs (average 720 mgm per cent.).

With regard to these strikingly high values in fur it may be pointed out that the phenol content of the urine of *T. vulpecula* was found to be considerably higher than in eutherian mammals. The phenol content of the seminal fluid was also found to be high in this marsupial. In all probability the secretions from the large sudoriferous glands, particularly in the sternal region (Bolliger and Hardy, 1944), are responsible for some of the phenols encountered in the fur. It is also suggested that the high phenol content in phalangers and other marsupials may have originated from their diet of leaves, which contain large amounts of phenolic substances.

In phalanger fur it has been possible to separate at least four substances reacting as phenols by partition chromatography. Work is in progress to investigate the nature of the phenolic substances found in fur and to extend this investigation to a wider series of eutheria and marsupials.

A. Bolliger,
R. Gross.*

Gordon Craig Research Laboratory,
Department of Surgery,
University of Sydney.
20 March 1951.

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Some Biological Effects of 1-Phenyl-3,5-dimethyl-1,2,4-triazole

The interaction of acetamide with serum proteins has been noted by Polya and Dunn (1950) and some evidence has been accumulated concerning the mild biological activity of some diacylimines prepared by Polya and Spotswood (1948). When it was decided to test other compounds derived from amides and diacylimines, 1,2,4-triazoles were considered for a number of reasons: they may be derived synthetically from diacylimines, formally they may be regarded as arising from two amidines fused within one system of high resonance, and their interaction with serum proteins and nucleic acid (Parkes and Polya) suggested the possibility of cytological effects other than general toxicity. 4-amino-1,2,4-triazole (I) was prepared according to Allen and Bell (1944), and the 1-phenyl-3,5-dimethyl (II), 1,5-diphenyl (III) and 1,5-diphenyl-3-methyl (IV) derivatives of 1,2,4-triazole have been prepared by a convenient modification of the method of Brunner (1914, 1915), details of which will be published elsewhere. Preliminary studies on *Allium cepa* indicate that I is more toxic and III or IV less effective than II. In experiments on rabbits (Professor F. H. Shaw, Department of Physiology, University of Melbourne) III appeared to be more toxic than II. II dissolves in water readily and its aqueous solutions may be used as solvents for nucleic acids. The following cytological observations refer to II, although the effects of the other investigated triazoles differ quantitatively rather than qualitatively.

II has four well-defined but overlapping effects on the root of *Allium cepa*: reduction of the division rate, *c*-mitotic action, induction of intercalary stickiness and general toxicity. These effects may be isolated by adjusting the conditions of treatment and recovery.

While recovery is still possible after two months' treatment with 0·1% II, such treatment for twenty-four hours is sufficient to reduce the division rate to nearly zero and to hold it at this level in recoveries for a few days.

Treatment with 0·5% II for short periods results in the rapid and extensive suppression of spindle action, formation of swellings on the elongating zone of the root, and chromosome contraction by about 50%. Polyploidy is difficult to detect owing to the low division rate.

Intercalary stickiness between chromosomes at anaphase (Figures 1 and 2) is observed during recovery from treatment with about 0·5% II. The growth of the roots is subsequently quite normal. The understaining with Feulgen stain, larger nucleoli and the probable decrease of spiralization, suggest interference of II with nucleic acid cycle.

Prolonged treatment or concentrations around 1% lead to granulation in the cytoplasm and general toxic effects leading to death.

The rapid suppression of spindle formation and the contraction of chromosomes induced by II suggested its use in fast squash methods to facilitate the counting of chromosome numbers of species with long chromosomes. Thus the chromosome numbers of the *Bulbine* and *Arthrotaxis* species have been determined in a few hours after treatment with 0·5% II.

It might be mentioned briefly that Miss E. Ashbolt and one of us (J.B.P.) have noted somewhat less distinct effects of II on brewer's

* Aided by a grant from the National Health and Research Council.

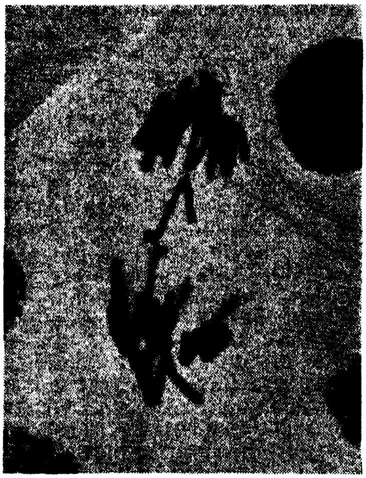

Figure 1

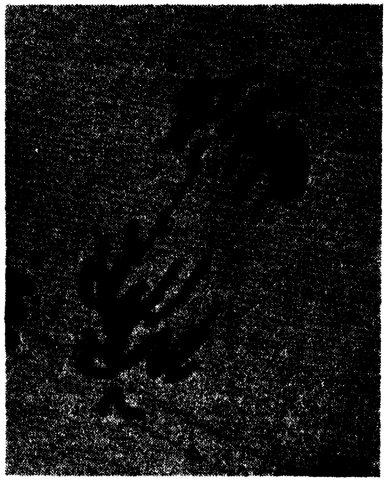

Figure 2.

Intercalary stickiness in root cells of *Allium cepa* induced by treatment with 0·5% 1-phenyl-3,5-dimethyl-1,2,4-triazole for eight hours; recovery forty-eight hours. (1600×.)

yeast, one of the clearest being a change of treated young colonies from the appearance of untreated aged colonies.

The purpose of this note is to draw attention to the interesting possibilities of new biological uses for 1,2,4-triazoles. It will be followed by detailed publications in the near future. The authors wish to acknowledge a grant from Mr. E. J. Hallstrom and are indebted to Professor H. N. Barber for his interest and advice.

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J. B. POLYA.

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University of Tasmania.
14 February 1951.

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Reviews

Reflections of a Physicist

REFLECTIONS OF A PHYSICIST. By P. W. Bridgman. (New York: Philosophical Library, 1950. 392 pp. 5½″ × 8¾″.) Price, $5.00.

Professor Bridgman of Harvard is a very distinguished American physicist. His experiments on the changes in the properties of materials brought about by very high pressure have earned him a Nobel Prize award. His scientific interests, however, extend far beyond the walls of his laboratory, and the republished speeches and writings collected in this volume cover a wide variety of topics. He has grouped them under five headings:

I. General Points of View
II. Applications to Scientific
III. Primarily Social
IV. Specific Situations
V. Prophetic

Despite the diversity indicated by these titles, Bridgman claims that all possess 'a certain inner unity' consisting in the adoption of a viewpoint common to a school of American physicists known as 'the operational method', the essence of which consists in defining the meaning of terms 'by an analysis of the operations which one performs in applying the terms in concrete situation'.

Such a procedure is obviously closely allied to the philosophical system known as 'logical positivism', the principle of which is the resolution of abstract and complex concepts into their ultimate perceptual elements, the 'things' of the objective world of our senses. How close is the similarity between logical positivism and operationalism may be judged by comparing a phrase used by one of its foremost exponents, Rudolf Carnap, with that from Bridgman, just quoted. It runs: 'We know the meaning of a term when we know under what conditions we are permitted to apply it in a concrete case.'

Bridgman's *Reflections* begin with two lengthy articles explaining and justifying the principle and method of 'operationalism'. The reviewer has to confess that he has found the

reading of them a somewhat tedious task. His personal opinion is that 'semantics' (the science of meaning) has about the same practical value in the pursuit of scientific inquiry as the theory of elastic collision has to the expert billiards player. Bridgman himself says of his own version: 'Operational analysis is valueless without a background of experience and the conclusions from such an analysis can have no validity which is not already conditioned by the experience'. (So what?) Also in his article entitled 'Science: Public or Private' Bridgman would seem to indulge in a somewhat 'painful elaboration of the obvious', as Henry James puts it.

It is true, as he insists, that a man's knowledge of science, like any other knowledge he may possess, is personal to him and in that sense 'private'. But 'science' surely exists quite independently of any particular individual's knowledge of it. Is it not just that impersonal and objective character which gives to science its universal validity?

Bridgman is happier when he deals with topics on or nearer to the technical scientific level. In 'The New Vision of Science' he discusses the implications of the breakdown of causal determinism in individual atomic processes (radiation, radioactivity, etc.) in scientific and also in non-scientific thought. He concludes that in the sphere of science it sets a boundary to scientific inquiry, whereas for the 'man in the street' it will simply 'set loose a veritable intellectual spree of licentious and debauched thinking'. Frankly, it seems questionable whether it will do either the one or the other; for on the one hand the realm of scientific thought is multi-dimensional and, on the other, even though causality may fail in atomic events statistical causality will continue to reign in the macroscopic aspects of practical life as vigorously as ever.

In 'The Struggle for Intellectual Integrity' Bridgman expresses his strong dissent with the views which a publicist (Adams) and a cleric (Harris) have published on the subject of the changing attitude of the present (1933) generation of college-men in matters of religion and morality. In his opinion, the true cause for the rejection of traditional religious creeds and faiths by so many lies in the acquirement of an enhanced sense of intellectual honesty due to their training in scientific thinking, which they naturally tend to apply in spheres other than the scientific. At the same time he freely admits that this practice is likely to have a disintegrative effect in our social institutions and, to this extent, he is inclined to admit the possibility of a 'decline in apparent morality' which, however, is 'the prerequisite to a general advance'.

Such questions as this—it seems to the reviewer—depend so vitally on the degree to which ethical standards are regarded as relative or as absolute that conclusions can have little if any scientific validity and merely reflect a personal attitude.

These samples of Bridgman's scientific and social philosophy may suffice to indicate to scientific and non-scientific readers what they may expect to find in *Reflections of a Physicist*.

KERR GRANT.

Alkaloids

THE ALKALOIDS: Chemistry and Physiology. Volume I. Edited by R. H. F. Manske and H. F. Holmes. (New York: Academic Press, 1950. 525 pp., numerous tables, charts and text-figs. $9\frac{1}{4}'' \times 6''$.) Price, $10.00.

The aim of the editors of this volume, which is the first of a series of five, is to produce 'something in the nature of a *Handbuch*' which will contain 'all the pertinent knowledge of the chemistry and pharmacology of the alkaloids'. They feel that such a difficult but necessary task could scarcely be accomplished by one author, and consequently the present work is a collaborative effort by several authorities. In order to keep the material up to date, it is intended to issue supplements from time to time. From information given on the dust cover it appears that the first four volumes will deal with the chemistry and the last with the pharmacology of the alkaloids.

The present volume contains seven chapters, or rather essays—since they are almost independent of each other. In the first, entitled 'Sources of Alkaloids and Their Isolation' (14 pp.), R. H. F. Manske discusses the occurrence of alkaloids in the plant orders and families, the distribution of alkaloids in the plant, and their isolation, separation and purification. This last section describes several valuable procedures, developed largely by the author himself who, as is well known, has repeatedly demonstrated their practical worth.

In the next chapter, 'Alkaloids in the Plant' (75 pp.), W. O. James considers the alkaloids in relation to the plants that produce them. In this stimulating account he summarizes and critically examines existing knowledge and foreshadows future developments. One gains the impression that little is known with certainty and that much remains to be discovered in this difficult field.

The remaining chapters are devoted entirely to the chemistry of five groups of alkaloids. The classification, which is made on chemical grounds alone, can be criticized on several points, but it is probably as sound and as convenient as any other which could be devised. The groups of alkaloids discussed are: 1. The Pyrrolidine alkaloids (16 pp.), by L. Marion; including hygrine, hygroline, cuscohygrine, carpaine, stachydrine, betonicine, turicine and 4-hydroxyhygrinic acid. 2. Senecio alkaloids

(56 pp.), by N. J. Leonard. 3. The Pyridine alkaloids (103 pp.), by L. Marion; including the pepper alkaloids, the areca-nut alkaloids, trigonelline, the pomegranate alkaloids, the lobelia alkaloids, ricinine, leucanine, the hemlock alkaloids, the tobacco alkaloids and ammodendrine. 4. The Tropaine alkaloids (103 pp.), by H. L. Holmes. 5. The Strychnos alkaloids (125 pp.), by H. L. Holmes.

Since it would be premature to pass judgment until all five volumes have been published, a few general remarks only will be made. The material presented seems to be as complete and as up to date as can be expected in a rapidly expanding field. Each chapter is written in a clear, readable style and the structure for each alkaloid, when known, is deduced logically, with frequent reference to structural formulae. Adequate attention is paid to alkaloid syntheses, and related matters of interest are briefly discussed. These features should render the book particularly valuable to the student. The plant sources of each alkaloid are, of course, quoted; and the physical constants of each alkaloid and its derivatives are fully set out, frequently in tables. Well over a thousand references are given; so the literature appears to have been fully covered. A curious feature is the inclusion of a few descriptions of practical operations relating either to the isolation or degradation of an alkaloid. These seem to be quite pointless, but since little space has been wasted, the criticism is a minor one. Subject and author indices are included, and the book has a pleasing format.

A suggestion which the editors might consider is that a complete table of alkaloids, their molecular formulae, their colour tests, their physical constants and their chief derivatives for identification purposes, together with a text reference, be included at the end of the fourth volume. Such a table would be invaluable to everyone working on alkaloids.

It is safe to conclude that no worker in this field can afford to be without a copy of this volume and that succeeding volumes will be awaited with keen anticipation.

E. Ritchie.

Bacteriology

Introduction to the Bacteria. By C. E. Clifton. (New York: McGraw-Hill, 1950. 528 + xii pp., 177 text-figs., 11 tables. 5¾″ × 9″.) Price, 5.00.

This book is admirably suited to science students commencing their bacteriology course. The scope of the book is defined by the author in his preface: '. . . the field of bacteriology is surveyed in such a manner as to introduce the student not only to descriptive bacteriology but also to the modern concepts of the *how* and *why* of bacterial behaviour'.

The author gives a concise and up-to-date account of the cytology and morphology of bacteria and an outline of the main characteristics of the protozoa, algae, moulds, yeasts, rickettsiae and viruses. Seven chapters are devoted to consideration of bacterial metabolism. The treatment follows an orderly pattern, consideration being given to the energy requirements; respiratory mechanisms; the metabolic classification of bacteria and the growth and death of bacteria. A chapter on microbial variations is deserving of special mention as it includes excellent introductory accounts of adaptation, dissociation and the use of induced variations in fungi (Neurospora), the latter section being very clearly presented both in the text and by diagrams.

The short chapter on classification presents the Bergey system, followed by a demonstration of the use of the same system for identification. There is no suggestion for improvement of the system. Applied aspects of bacteriology, such as problems associated with the bacteriology of soil, water, air, food and industrial fermentations, are adequately treated for introductory purposes. In keeping with the author's attempt to produce a general text, aspects of infection and resistance, serological reactions and the microbiology of infectious diseases are only briefly (perhaps too briefly) treated.

The style of writing is conversational and hence easy to read, yet it still remains concise. The book is illustrated with some fine photographs and diagrams; charts are used to good effect to demonstrate metabolic pathways. The American system of nomenclature is adhered to strictly.

V. B. D. Skerman.

Botany

Jan Ingenhousz, Plant Physiologist; With a History of the Discovery of Photosynthesis. By H. S. Reed. *Chronica Botanica, 11*, 5-6. (Waltham, Mass.: Chronica Botanica, 1949. 112 pp., 8 plates. 7″ × 10¼″.) Price, $3.00.

While the study of the history of science continues to be both fashionable and profitable, little has been written in a general way to interest the non-specialist on the history of plant physiology. We should therefore be grateful to Dr. Howard S. Reed who has given us a valuable contribution on Jan Ingenhousz, one of the founders of the science of plant physiology who, in the late eighteenth century, discovered the action of light on green plants. He was a contemporary of Scheele and Priestley and explained the disagreement between them. Priestley had failed to differentiate between the two processes of gas evolution occurring respectively in the dark and in the light, and Scheele observed only one of these processes because the light intensity on his plants was apparently

too low. After some biographical sketches and historical background, the annotator reproduces the text of the classical work by Ingenhousz in its English (1779) edition. The original work, together with some footnotes which show how Ingenhousz's discoveries fit into more recent ideas, make interesting reading. This historical work can be recommended to biologists and chemists.

R. N. ROBERTSON.

Chemistry

INTRODUCTION TO TEXTILE CHEMISTRY. By B. E. Hartsuch. (New York: John Wiley; London: Chapman and Hall, 1950. 413 + ix pp., 56 tables. $5\frac{1}{4}'' \times 8\frac{1}{2}''$.) Price, $4.75.

Too many textbooks, describing recent developments in particular fields of technology, deal inadequately with the basic scientific principles underlying the industrial processes concerned and the properties of the industrial products. Professor Hartsuch has had wide experience as a teacher of chemistry in the U.S.A., and his book on textile chemistry is a well-balanced and up-to-date account of the theoretical and industrial aspects of the subject.

It is intended primarily as an introductory text for students who may have had little previous chemical training. The first chapter is devoted to elementary calculations of the type likely to be encountered in textile chemistry, and the second deals with organic chemistry. Only those aspects of organic chemistry are covered which have a fairly direct bearing on the manufacture of textiles, but the account serves as a useful 'refresher' for those who have received a broader training in the subject. Questions are presented at the end of each chapter to enable the reader to assess his progress.

The production, properties and mode of action of soap are treated in some detail, in recognition of its importance in scouring and finishing processes, and then follows a useful summary of the chemistry of some of the newer detergents. Difficulties due to variation in the composition of the water used in processing are outlined, and methods are described for eliminating impurities, such as those which cause hardness. A classification of textile fibres is presented together with a general description of their physical properties. An account of the chemistry of cellulose serves as an introduction to a detailed consideration of cotton and the cuprammonium, viscose and acetate rayons. Other chapters deal with wool, silk, nylon, synthetic fibres such as vinyon and orlon, and artificial protein fibres from zein and soybeans. A useful glossary of technical terms used in the textile industry is provided at the end.

The book is well produced and contains few typographical errors. It is perhaps unfortunate that Hartsuch follows the lead of some other authors in presenting unproved structural formulae for the peptide chains in wool; and, in discussing the action of alkali on wool, he fails to mention the well-known conversion of cystine to lanthionine. In general, however, the information presented appears to be reliable and the text is well-documented with footnote references to original journals and patents. Most important is the fact that this is probably the only textbook in the English language which both surveys modern views on the chemistry of well-established natural textile fibres and outlines the basic principles underlining the more spectacular developments in the field of man-made fibres. A book which covers these fields so clearly and thoroughly is assured of a strong demand, not only by students but also by chemists engaged in research and in industry.

F. G. LENNOX.

BORON TRIFLUORIDE AND ITS DERIVATIVES. By H. S. Booth and D. R. Martin. (New York: John Wiley; London: Chapman and Hall, 1949. 316 + x pp., many text-figs. and tables. $5\frac{3}{4}'' \times 8\frac{1}{2}''$.) Price, $5.00.

Fifteen years ago an enterprising American company began the manufacture of a chemical which previously occurred mainly on the pages of textbooks. Now boron trifluoride joins the distinguished company of such compounds as water, aluminium chloride and penicillin in having had a whole book written on it. The ready availability of boron trifluoride has stimulated research to such an extent that references to over 1000 papers and patents are listed in this book. The authors went to immense trouble to collect the relevant data scattered through all the domains of chemistry; they have scanned *Chemical Abstracts* page by page from its beginning to the end of 1947. They have also obtained the co-operation of industry to an unusual extent; eighteen companies have given them information on their processes.

The book is thus an apparently complete, though not an inspired, account of the physical and chemical properties of boron trifluoride and its compounds. The most important chapters deal with its co-ordination compounds, with fluoboric acids and their salts, and with the use of boron trifluoride as a catalyst. There is much in these chapters to interest the organic chemist. There are also chapters on the manufacture and the analysis, and well-illustrated instructions on the handling, of boron trifluoride.

The general appearance, the printing, and the indices are of the usual high standard of Wiley books. This volume will be a welcome addition to library shelves; but there may not be many chemists in Australia who can afford to buy a book dealing with only one compound!

S. J. ANGYAL.

Colloids

A Textbook of Colloid Chemistry. Second edition. By H. B. Weiser. (New York: John Wiley; London: Chapman and Hall, 1949. 444 + x pp., 117 text-figs., 73 tables. 6″ × 9″.) Price, $5.50.

The second edition of this well-known textbook describes itself as follows:

> . . . the whole field of Colloid Chemistry treated from the classical point of view. Illustrations of theoretical and applied principles are drawn from the modern, as well as the classical, work.

Few would dispute the importance of a sound historical approach to Colloid Chemistry, but the greatness of the classical work is not enhanced by ignoring, as the present author almost invariably does, the impact of advances in physical chemistry of the last twenty-five years. This undue reverence for the past may perhaps explain, although it does not justify, some major omissions such as synthetic polymers and most of the last twenty years' work in Colloid and Surface Chemistry. The still widespread belief that 'Colloids' are subject to laws of their own, and not to the well-established principles of physical chemistry, will unfortunately be strengthened by many statements in the book.

Whilst it is inevitable, and from some angles desirable, that any textbook of a general nature should lag somewhat behind the most up-to-date opinions, there seems no reason why our already overburdened students should be inflicted with so many outmoded theories and concepts. A typical example is the treatment of the stability of hydrophilic colloids in terms of 'hydration shells', and Bancroft's theory (1926) of the effect of ions on the association equilibrium of water.

The reviewer would not recommend this book to anyone wishing to learn the fundamentals of Colloid Chemistry and still less to anyone interested in the modern trends.

A. E. Alexander.

Entomology

Biology of Drosophila. Edited by M. Demerec. (New York: John Wiley; London: Chapman and Hall, 1950. 632 + x pp., many text-figs., tables. 5½″ × 8½″.) Price, $10.00.

This very valuable publication consists of a comprehensive and detailed account of the anatomy, histology and development of the well-known laboratory insect, *Drosophila melanogaster*. Under the editorship of M. Demerec, contributing authors are Kenneth W. Cooper (normal spermatogenesis), B. P. Sonnenblick (early embryology), D. F. Poulson (histogenesis, organogenesis, and differentiation in the embryo), Dietrich Bodenstein (post-embryonic development), G. F. Ferris (external morphology), Albert Miller (internal anatomy and histology of the imago) and Warren P. Spencer (collection and laboratory culture). As stated by the editor, plans for the preparation of this volume were made some ten years ago and a research programme was initiated which was designed to fill gaps in the information still remaining at that time, and so to give an absolutely complete account of the development of this organism. This has been most successfully achieved and the volume will be invaluable to zoologists, geneticists and entomologists. The bibliography includes some 470 references; all sections are extremely well illustrated; and developmental processes are clearly tabulated. The book's value is greatly enhanced by the extremely full subject-index prepared by A. Miller. The authors and the research workers associated with them are to be congratulated on a very fine achievement.

A. Woodhill.

Engineering

Handbook of Experimental Stress Analysis. Edited by M. Hetényi. (New York: John Wiley; London: Chapman and Hall, 1950. 1077 pp.) Price, $15.00.

Contents: 1. Mechanical properties of materials. 2. Testing machines. 3. Mechanical gauges and extensometers. 4. Optical methods of strain measurement. 5. Electrical-resistance gauges and circuit theory. 6. Electric inductance gauges. 7. Electric capacitance gauges. 8. Motion measurements. 9. Strain rosettes. 10. Working stresses. 11. Residual stresses. 12. Methods of crack detection. 13. Interpretation of service fractures. 14. Brittle models and brittle coatings. 15. Structural model analysis. 16. Analogies. 17. Photoelasticity. 18. X-ray analysis. *Appendices*: 1. Fundamentals of the theory of elasticity. 2. Dimensional analysis. 3. Precision of measurements.

The long-felt need for a comprehensive handbook of existing methods of experimental stress analysis has been met by this book. As appears from the table of contents, the book covers the field completely, furnishing information previously found scattered through a multiplicity of references. Furthermore, a certain amount of specific practice is given. Such information is not usual in handbooks, but from the successful manner in which this information has converted the usual 'skeleton' form of a handbook into a readable account of the subject, it should be much more generally given.

A feature of the book is the article on analogies, which the reviewer found particularly stimulating. This material has been particularly well secreted in current literature, but in this book a clear and concise account of all the known 'usable' analogies has been given. It is interesting to note that Kron's Analogue of the elastic field has been particularly well presented.

Throughout, the presentation is clear and attractive, amply illustrated by diagrams and drawings. Generally, the standard of mathematical ability required is that for a degree.

course, so that the book is intended, as its title implies, for specialists in the field. Taking the appendices into account, however, the presentation should not be beyond any graduate engineer, and it is the reviewer's opinion that the book would be of assistance and interest to all engineers concerned with the strength of materials.

C. A. M. GRAY.

Sediments', are important and give much new and useful information.

This book can be recommended to all senior students of Geology as a reference for additional reading in petrology courses. The format, printing and binding are of the usual high standard produced by McGraw-Hill. Very few errors or omissions were noted.

DOROTHY CARROLL.

Geology

PRINCIPLES OF SEDIMENTATION. By W. H. Twenhofel. Second edition. (New York: McGraw-Hill, 1950. 673 pp., 81 text-figs. 9¼″ × 6″.) Price, $6.50.

The publication of this second edition of an American standard textbook indicates its usefulness in the study of sedimentary materials and sedimentary rocks. Since 1939, when the first edition appeared, much new work on the subject has been done in the United States, Holland, France, Germany, and the East Indies, and this has been incorporated in the new edition, which, however, retains the style and arrangement of the former. The book is supplementary to the *Treatise on Sedimentation* by the same author, who is one of the foremost authorities on sedimentation, Professor Emeritus of Geology in the University of Wisconsin, and who has been Editor-in-Chief of the *Journal of Sedimentary Petrology* since its inception in 1931.

In presenting the subject, emphasis is placed on the concept that sediments are products of heritage and, more particularly, of environment; the aim is to give a better understanding of sedimentary processes and sediments. From the student's point of view Chapters 2 and 3, 'The Environmental Factors' and 'Classification and Consideration of Environments', are the most important, introducing as they do the idea of a physiographic cycle and indicating its connexion with a sedimentary cycle—an idea now universally accepted. The classification of environments into continental (terrestrial and aqueous), mixed continental and marine, and marine, is tabulated on page 54 and shown diagrammatically in Figure 7.

Chapter 4, 'The Origin of Inorganic Sediments', summarizes the sources of sedimentary materials, including soils, and indicates the means whereby such material may arrive at the place of sedimentation. Other chapters deal with 'Organisms and Sediments', 'Transportation and Deposition of Sediments', 'Classification of Sediments', and then there are a series of chapters on the various kinds of sediments —clastic, chemical (carbonates, siliceous, ferruginous, manganese-bearing, carbonaceous, phosphatic, and evaporites). These follow the usual lines for describing these materials. The two final chapters, 'Structural Features of Sedimentary Material' and 'Textures and Colors of

Mathematics

RESPONSE OF PHYSICAL SYSTEMS. By J. D. Trimmer. (New York: John Wiley; London: Chapman and Hall, 1950. 268 + ix pp., 93 text-figs., 4 tables. 5½″ × 8½″.) Price, $5.00.

Some thirty years ago a series of lectures on 'Mathematical Methods' was introduced into the Cambridge Mathematical Tripos course. Partly the need for this series was the outcome of a system in which each individual lecturer lectured on his particular subject—mechanics, hydrodynamics, gravitation, or electricity and magnetism—without reference to other lecturers, so that the basically identical differential equations were solved again and again for the same students. The Mathematical Methods lectures were meant to dispose of the solution of these differential equations, leaving the various lecturers to develop their own subjects on an assumed basis of knowledge of the solutions. One, possibly remote, consequence of the series is Jeffreys and Jeffreys *Methods of Mathematical Physics*, but, in any case, the unified mathematical approach to the problems of physics and engineering is now a commonplace.

In *Response of Physical Systems* the unification is complete. The same symbols are used in the equation whatever the physical system under discussion, the relation of the symbols to the properties of the physical system being clearly explained in each case. The differential equation is taken as representing a basic process in which 'something' acting through a physical system produces a certain 'reaction'. The 'something' Trimmer calls a *forcing* and the 'reaction' *response*. In the linear differential equation, written in the form $f(d/dx)y = \phi(x)$, the function ϕ is the *forcing*, the function f (together with initial conditions) is the *system*, and the solution is the *response*. The response again is separated into two parts, the *transient response*, which is what is usually termed the complementary function, and the *forced response*, which is a particular integral.

The purpose of the book is not the formal solution of the equations. For each type of equation the complementary function is stated, and a list provided of the particular integrals most usually required. Then follows a full description of some physical problems to which the equation may be applied, with a survey of

what factors in the physical problem have to be neglected in order that the equation may be taken as a mathematical description of the problem. The various physical coefficients are reduced to the author's universal form, and the solution of the equation is then interpreted in terms of the physical problem.

The first six chapters are devoted to physical systems which can be made to depend, approximately, on linear differential equations with constant coefficients. The seventh is an interpolation dealing, and dealing very lucidly, with measurement. The remaining four chapters discuss the simpler systems which depend on linear equations in which the coefficients are not constants, and on non-linear equations. There is an Appendix on the Laplace Transform which, besides being a good account of the method, contains a very fair assessment of its power and utility. One comment in particular is worth quoting (p. 251): 'The Laplace transformation, like other mathematical methods, is useful in proportion to the care and thoroughness with which it is studied and practised. It is not a magic short cut to anything, nor does it, generally speaking, permit the solution of problems which may not be solved otherwise'.

The author makes reference from time to time to Wiener's *Cybernetics*, but while *Cybernetics* is, in a sense, a book of mathematical prophesy, *Response of Physical Systems* is very much a book of the present. Two chapters of the two books may in fact be directly compared, namely those on Measurement and on Feedback; Trimmer's very clear and readable accounts of these subjects provide a good take-off for Wiener's flights of mathematical fancy. The following quotation from Trimmer's chapter on Measurement, while not saying anything new, gives a fair idea of the style in which the less formal part of the book is written (p. 147):

> The concept of noise plays a very important role in the response of physical systems. The symbol q_n was introduced for noise, with the understanding that it was any forcing to which the desired response is zero or as near zero as one can get. Now, as q_d becomes smaller, it eventually reaches a magnitude comparable with q_n; and finally the spurious response to q_n overshadows the response to the true value q_d. Various schemes have been developed for reducing the response to q_n, but no scheme is fully successful. For noise is an inevitable reflection of a basic feature of physical nature—a kind of 'graininess', or statistical irregularity. The physical quantities, which seem to pour like a continuous fluid at their higher values, take on, as their magnitudes are reduced, some of the properties of a collection of Mexican jumping beans.

The knowledge of Mathematics assumed by Dr. Trimmer is very much that which Australian universities provide for Engineering students. Any physicist or engineer will find many hours of stimulating reading in this book; so indeed will many mathematical students, for it breathes life into the rather dreary routine of elementary differential equations.

T. G. Room.

Nuclear Science

Photons and Electrons. By K. H. Spring. (London: Methuen, 1950. 108 pp., 38 text-figs. $4\frac{1}{4}'' \times 6\frac{3}{4}''$.) English price, 7*s.* 6*d.*

This monograph is concerned with the various ways in which electrons and radiation interact. The first chapter reviews the fundamental developments in knowledge of electron and proton behaviour over the past fifty years. The second chapter is devoted to the photoelectric process, considerable attention being paid to the spatial distribution of photoelectrons; this is followed by a chapter on the Compton effect. The fourth chapter, which is concerned with the reciprocal processes in which protons are ejected by electrons, discusses the spatial and intensity distributions of X-rays and concludes with a short account of the Cerenkov radiation. The fifth chapter comprises a well-written account of positrons, which includes discussions of angular and energy distributions of electron pairs and the annihilation of positrons. The concluding chapter considers the application of the results discussed in the earlier chapters to the very-high-energy cosmic-ray electrons and photons.

This excellent little book should be welcomed by physicists. It includes within the compass of its hundred pages a summary of many important theoretical results. The book is well balanced between theory and experiment; each account of a theoretical development being, in general, followed by a useful survey of the associated experimental results. An adequate reference list is to be found at the end of the book.

A few statements in the book suggest that perhaps a considerable time has elapsed between preparation of the script and its appearance. For example, in a book published in 1950 it appears a little inadequate to quote 180m as the best experimental value for the mass of the meson, even when a footnote is added regarding the suspected existence of both lighter and heavier types of mesons. For some two years or more, experimental evidence has been definite in regard to the existence of, at least, mesons of masses approximately 210m and 280 m.

For one who has been interested in the expansion chamber for many years, it is refreshing, in these days when the exponents of new and revived techniques for detection of atomic particles are numerous, to be reminded of the significant and considerable part played by the expansion chamber in various investigations concerned with the interaction of electrons and radiation.

J. C. Bower.

Relativity

MATHEMATICS OF RELATIVITY. By G. Rainich. Applied Mathematics Series, edited by I. S. Sokolnikoff. (New York: John Wiley; London: Chapman and Hall, 1950. 173 + vii pp. 5¾" × 9".) Price, $3.50.

This latest addition to the many texts on the theory of relativity is characterized by a concise but very thorough mathematical treatment. For within the space of 173 pages the author covers not only the special and the general theory together with the necessary development of the tensor calculus, but gives also the broader background obtained with the inclusion of electromagnetism (as far as special relativity is concerned). This tightness of presentation —with all loose ends neatly tied up—will have resulted largely from the author's twenty years of experience in teaching the subject, but of course it does not make for easy reading; and the text may be found somewhat dehydrated and indigestible by those who possess little mathematical background and by the dilettante interested in relativity. There is not a single diagram in the book! But physicists and mathematicians wishing to study the subject seriously will find the book clear and useful, and will appreciate the broad treatment of all the material as a consistent whole.

While comparatively little has been added to the theory of relativity in the many years since its inception, the presentation here is fresh and in some respects novel. The mathematical tools are introduced step by step only as required, thus spreading the difficulties. Tensors are introduced as a generalization of vectors and treated to a large extent in the notation and from the standpoint of vector analysis (similar to the approach of E. A. Milne in Chapter III of the comparatively recent book, *Vectorial Mechanics*), with consequent gain in understanding.

The main plan of the various chapters is briefly as follows: I. Old Physics (Motion of a point and of a fluid in vector and tensor notation respectively; Maxwell's equations and the stress-energy tensor); II. New Geometry (Four-dimensional analytic geometry; tensor analysis; the imaginary coordinate); III. Special Relativity (Lorentz transformations; photons; electricity and magnetism; the complete tensor); IV. Curved Space (General coordinates; the Riemann tensor; geodesics); V. General Relativity (The law and equations of geodesics; the three tests of the theory). In keeping with the essentially mathematical mode of presentation, no reference is made to the so-called paradoxes of relativity, or to the early experiments on 'ether drag', aberration of light and so on. Also, no attempt is made to cover the cosmological theories of the 'shape' and the expansion of the universe, as these lie outside the basic theory and are somewhat speculative anyway.

It merely remains to add that the printing is clear and the style of the author lucid; but that the price, for a book of its modest size—while attractive enough in the United States—is repellent in this country, thanks to the continued depreciation of the Australian pound.

C. B. O. MOHR.

Spectroscopy

THE IDENTIFICATION OF MOLECULAR SPECTRA. By R. W. B. Pearse and A. G. Gaydon. (London: Chapman and Hall, 1950. 276 pp., 12 plates. 7¾" × 11".) English price, £2. 10s.

The first edition of this book appeared in 1941. The writers claim to have included in this second edition new data as late as November 1949, and to prevent undue bulkiness have arranged many of the tables in a more compact form. The last section of the book is devoted to what is described as 'Practical Hints', which are not to be despised in spite of their brevity. No diagrams are included, but there are a number of excellent plates.

T. IREDALE.

Statistics

INTRODUCTION TO THE THEORY OF PROBABILITY AND STATISTICS. By Niels Arley and K. Buch. (New York: John Wiley; London: Chapman and Hall, 1950. 236 pp., 5 tables. 9¼" × 6".) Price, $4.00.

The reviewer has found this book very stimulating. It is a translation from the Danish of a book 'which has already an enviable record in Continental Europe'—to quote the editorial preface. The translated preface to the Danish edition specifies the purpose of the book as giving 'an elementary introduction to the theory of Probability and Statistics with special reference to its practical applications', and claims to follow the English school founded by Fisher. Nevertheless, the student of Statistics accustomed to the type of textbook used as an introduction to the subject in English (and Australian) universities, even in those courses where it is taught only as an interesting piece of pure mathematics, will find the content and approach of the book very unfamiliar.

To some extent this is a matter of notation; in most cases the more usual 'English' equivalent notation is given as a footnote the first time a term is introduced, but the difficulty of translation to more familiar terms persists for some long time. But most of the unfamiliarity will be found in the general approach, which begins with a very formal discussion of philosophical-mathematical concept of probability and does not enter the field of practical application until at least two-thirds of the book has been mastered. The exceptions to this are the 'examples' drawn from the field of Statistical

Physics and the Quantum Theory which are scattered through the earlier sections; and one cannot avoid the impression that the book is mainly directed to readers who are good mathematicians and who are also mainly seeking to apply the technique in the Physical Sciences.

Nevertheless, if the book will appear difficult to readers who are not well equipped mathematically, there is much in it to recommend. The attention paid to the work of Polya and Kapeteyn, usually so much neglected by English writers and so difficult to obtain in the original, makes the book very valuable to anyone interested in theoretical distributions other than the normal curve and the other standard types. The uses of the 'probit' method to determine curve types and the parameters will also be new to many English readers. Finally, the careful annotation of every term when first introduced, not only with other English terms that have been used by other writers, but also with the corresponding French and German terms, makes the book almost a technical dictionary as well.

If not perhaps a book to recommend to students, it certainly remains one that every person who is teaching Statistics should have on his shelves.

R. S. G. RUTHERFORD.

AN INTRODUCTION TO PROBABILITY THEORY AND ITS APPLICATIONS. Volume 1. By W. Feller. (New York: John Wiley; London: Chapman and Hall, 1950. 419 + xii pp., tables. 5¾" × 9".) Price, $6.00.

This book sets out 'to treat probability theory as a self-contained mathematical subject rigorously avoiding non-mathematical concepts', while at the same time developing a feeling for the practical applications. The result is a very happy blend.

The approach to probability is directly through the 'sample space', which is developed very simply and easily in the first two chapters; this is followed by three chapters on combinatorial problems. Further chapters on the Binomial, Poisson and Normal Distributions follow, and it is only in Chapter 9 that the explicit term 'random variable' is introduced, at which stage the reader is well prepared for it. This unusual treatment seems very well justified both logically and in the result of a very readable textbook (in so far as a mathematical textbook can ever be readable!)

But it is in the concluding chapters of the book that its chief value lies. These chapters, dealing with Recurrent Events, Random Walk and Ruin Problems, Markov Chains, and Time Dependent Stochastic Processes, represent the first attempt to bring the topics out of their inaccessibility in the mathematical journals, and to present them in an exhaustive but understandable way. The present reviewer looks forward to many hours of closer study of these sections, and even more to the subsequent enlightenment and perhaps the ability to read more of the current literature.

This first volume is restricted to *discrete* sample spaces. The continuous case, together with the general theory of random variables and their distributions, limit theorems, diffusion theory, etc., is promised in a succeeding volume.

R. S. G. RUTHERFORD.

Thermodynamics

CHEMICAL THERMODYNAMICS. By F. D. Rossini. (New York: John Wiley; London: Chapman and Hall, 1950. 514 + xix pp., many text-figs., tables. 5½" × 8½".) Price, $6.00.

THERMODYNAMICS. By J. R. Partington. Fourth edition. (London: Constable, 1950. 263 + vii pp., 43 text-figs., tables. 5½" × 8½".) English price, £1. 2*s*. 6*d*.

Originally developed some hundred years ago as an aid to the understanding of the performance of the steam engine, the science of Thermodynamics invaded the field of physical chemistry in the second decade of the present century. Theoretical developments in this field have been rapid and research workers in physico-chemical subjects soon learned to apply the principles thus developed. The use of these same principles in large-scale chemical endeavour followed a little more slowly, but has shown signs of rapid expansion in recent years. For this reason the appearance of two new books, one British and one American, is to be welcomed.

Both books take the reader from first principles in thermodynamics up to the stage where application of thermodynamic principles to chemical practices becomes a routine matter. Both authors provide numerous examples whereby the reader can test the completeness of his grasp of the subject. But whereas Partington appears to be most meticulous in laying down basic principles and in circumventing mathematical difficulties, Rossini appears to want to take his reader up to the stage of application by the quickest possible route. He assumes little prior knowledge of physical principles in so doing, but does assume a more complete knowledge of mathematical operations including partial differentiation.

Partington's book is the fourth edition of a textbook which has become a standard in its class. This particular edition differs in only minor respects from the third edition published in 1940. A few of the sections dealing with entropy and free energy have been enlarged and there has been a change in the method of derivation of some of the thermodynamical equations. The three chapters dealing respectively with Non-ideal Solutions, the Nernst Heat Theorem and Statistical Methods have also been enlarged slightly. The values of the

general physical constants listed at the end of the text have been brought up to date and a valuable appendix has been added. This deals with a number of the basic principles in Mathematical Physics which are used in thermodynamics and give alternative proofs for some common thermodynamical expressions.

While the book by Rossini is a first edition, the author is particularly well known to the scientific public. He has been the author of a particularly large number of important papers on aplied thermodynamics and the co-author of a number of books on physico-chemical subjects. His present book will appeal particularly to those concerned with large-scale application of thermodynamical principles. His penultimate chapter gives examples of the application of these principles to a long list of chemical and chemical engineering operations, including petroleum technology and fractionation. The book is completed with a guide to the sources of data for thermodynamical calculations and an appendix giving useful conversion factors.

R. C. L. Bosworth.

Zoology

Physiological Mechanisms in Animal Behaviour. Symposia of the Society for Experimental Biology, No. 4. (Cambridge: University Press, 1950. 482 + vii pp., 12 plates, many text-figs. and tables. 6″ × 9¾″.) English price, £1. 15s. net.

Papers read at the Symposium of the Society of Experimental Biology in Cambridge in 1949 are collected in this book. They cover a tremendously wide field, from pure physiology such as Adrian's short paper on the control of nerve-cell activity to a philosophical discusson of vitalism and mechanism by Lorenz. The contributions do not form a particularly integrated unit but they have nevertheless been arranged under four main headings: the range and capabilities of sense organs; central and peripheral control of behaviour patterns; instincts, taxes, etc.; and a final section on learning.

A good deal of the interest in the symposium lies in the last two sections, as they bring together papers by such distinguished European workers as Tinbergen, Lorenz and Baerends, whose writings on instinctive behaviour have not been readily available to Australian zoologists. Free rein is given to the typically European concepts of 'releaser mechanisms', 'reaction specific energy', 'vacuum activity' and 'mood hierarchy' so ably demonstrated in Tinbergen's studies of the stickleback. The contributors to this section tend to assume that the reader has at least a superficial knowledge of these terms; some of them are introduced before they are clearly defined. For those who have not a bird's-eye view of the trend of European thought on instinctive behaviour, the reviewer recommends a preliminary reading of Thorpe's excellent survey entitled 'The Modern Concept of Instinctive Behaviour' published in the *Bulletin of Animal Behaviour*, No. 7 (1948). It is a disappointment that none of the authors make any reference to the American school of McCulloch, Wiener and Bigelow, with their interpretation of purposive behaviour in terms of feedback mechanisms. The statement of Lorenz (p. 229) that 'no mechanist (apart from Pavlov) ever raised the question after a causal explanation of directiveness and purposivity of behaviour' surely ignores the interpretations of this American school. The general discussion of instinctive behaviour is preceded by contributions from Pantin and Smith on the nervous system and behaviour of Coelenterates and Starfishes respectively.

In an analysis of learning Thorpe adds to the usual categories of 'trial and error learning' and 'insight learning' two other categories, 'habituation' and 'imprinting'. He further differs from the orthodox approach in extending the meaning of insight learning to cover non-visual senses such as olfaction. 'Is not insight', he asks, 'merely the counterpart in form vision of that power of generalization which seems to be characteristic, in some degree at least, of all perceptions?' In this section of the book Lashley deals with the difficult subject of localization of memory in particular areas of the brain.

The section of the symposium on sense organs and nerve mechanisms is of more specialist interest than the above. Lowenstein summarizes knowledge of the function of the labyrinth, to which he has made notable contributions in his own researches. Pumphrey gives an account of the evolution of hearing, and tells us that the hiss of a snake is likely to be louder and more shrilling to the rat than the lion's roar to us! Miss Tansley gives a comparative account of visual acuity and colour vision. Lissman deals with proprioceptors.

The problem of central and peripheral control of behaviour patterns is discussed by Adrian from the side of the activity of the nerve cell itself. Weiss summarizes experimental operations in Amphibia and other animals which throw light on the same general problem. Gray deals with the question of whether an animal can initiate and maintain patterns of co-ordinated muscular movement without reference to the external world. The answer, as far as the Polychaetes is concerned, is given in another chapter on this subject by Wells, in his discussion of spontaneous rhythmic activity in Polychaete worms.

Because this book is a collection of papers each delivered without any special reference to other papers in the symposium, it has its inevitable limitations. There is no index and there is no uniformity in the bibliographies at the end of chapters. On the other hand, it contains much information which is otherwise

quite inaccessible to the average zoologist. Senior students and lecturers will want to possess a copy. It can be said to maintain the high standard of the preceding three symposia of the Society for Experimental Biology.

L. C. BIRCH.

THE MAMMALS OF VICTORIA. By C. W. Brazenor. National Museum of Victoria: Handbook No. 1. (Melbourne: Brown, Prior, Anderson Pty. Ltd., 1950. 125 pp., 1 coloured plate, many text-figs. 5½" × 8½".)

Both the layman and the professional zoologist will find this an attractive and satisfactory little book and, while its title is *Mammals of Victoria*, it is in most cases equally useful for all the States.

The book is divided into two main sections. First, a semi-popular account of the Class Mammalia with special mention of the dentition and reproductive systems of the marsupials, followed by a series of illustrations and short notes of the Victorian mammals. The second section is more for the specialist since it deals in some detail with the dentition of the marsupials and monotremes.

The descriptive notes, as well as the exposition of the more general matter, are clear and relevant, while the half-page text-figures are excellent and should make identification in the field a matter of moments.

J. R. SIMONS.

Book Notices

TEST WALLS FOR ASSESSING CONSTRUCTION TIMES WITH NEW BUILDING BLOCKS. National Building Studies Technical Paper No. 9. (London: H.M.S.O., for D.S.I.R., 1951.) English price, 9*d*.

The practical value of any new type of building block is dependent on the construction time of buildings in which it is used. The Paper gives details and results from small-scale test walls, which include all the main features of construction of a full-scale house. Taken in conjunction with existing data for other types of building block, the results allow construction time for small houses to be assessed.

QUARTZ VIBRATORS AND THEIR APPLICATIONS. By P. Vigoureux and C. F. Booth. (London: H.M.S.O., for D.S.I.R., 1951.) English price, £1 10*s*.

Since the discovery of the piezo-electric effect in 1880 the importance of the quartz crystal in research and in practical application has grown. In radio, electronics, and ultrasonics, increasing numbers of applications for quartz vibrators are being found. During the years 1938-1945, for instance, the production of crystal units increased from 10,000 to 1,500,000. *Quartz Vibrators and Their Applications* deals with the subject of piezo-electricity from both the theoretical and practical aspects and the work is intended to provide comprehensive information on the qualities and uses of quartz vibrators.

The applications described include frequency generation, multi-channel telephony, radio transmission, ultrasonic submarine detection and accurate time-keeping. Sections of the book are devoted to the structure and properties of raw quartz, the examination and selection of quartz for specified purposes, and the problems of bulk manufacture of crystals.

COMMUNICATION CIRCUIT FUNDAMENTALS. For Radio and Communication Engineers. By C. E. Smith. (New York: McGraw-Hill, 1949. 401 pp., numerous text-figs. and tables. 9¼" × 6".) Price, $5.00.

This is the second of four books designed for a complete course in radio and communication engineering. The material has been prepared for home study to meet the needs of radio operators and broadcast technicians. The book covers the physics of circuit elements, including vacuum tubes, and presents the fundamentals of alternating and direct current circuits.

THE EFFECT OF INSECT REPELLANTS AND INSECTICIDES ON BITUMEN/PAPER LAMINATES USED FOR WRAPPERS AND CASE LINERS. By A. L. Temby and E. C. Kuster. (D.R.L. Technical Note No. 11. 16 pp., 19 photos. 5½" × 8½", paper covers.) Obtainable from Defence Research Laboratories, Private Bag No. 4, Ascot Vale, W.2, Victoria. Free.

Following reports of textile goods wrapped in bitumen/paper laminates being stained when naphthalene and *p*-dichlorbenzene were used as moth repellants in the packages, the effects of these matrials and DDT on bitumen/paper laminates under various (simulated) climatic conditions were investigated. A DDT/talc mixture is recommended for moth-proofing textile goods during storage.

LIST OF SPECIES MAINTAINED IN THE NATIONAL COLLECTION OF TYPE CULTURES. Second Edition. Issued by the Medical Research Council of Great Britain. (London: H.M.S.O., Box 569, S.E.1.) English price, 9*d*.

This is a revised edition of the list providing information on all of the cultures available at the National Collection and on the number of strains that are maintained of each species.

RADIO RESEARCH, 1933-1948. (London: H.M.S.O., 1950.) English price, 2*s*.

Radio Research, 1933-1948, includes details of the first year's work of the separate Radio Research Organization which was set up by D.S.I.R. at the end of 1947. Up to 1933 the activities of the Radio Research Board were described in a few special reports and after that in the annual reports of the National Physical Laboratory, where the majority of the radio investigations have been carried out. An extended programme of research was started on in 1949 and in future the progress of the work will be reported annually.

Much of the research work carried out has been concerned with the propagation of radio waves along the ground and through the upper atmosphere, and their development and use for direction and position finding. Other important work was the investigation of atmospheric noises and their causes, thunderstorms and lightning flashes. The practical technique and experience gained in this research enabled the first demonstration of radar to be given by staff engaged on the programme of the Radio Research Board.

The present research programme includes an investigation of the communication possibilities of the shorter wavelengths now being used for radio-telephone relay links and television, and valuable data have already been accumulated. Work continues on the use of long waves for precise navigation and surveying purposes, and on the application of radio techniques to meteorology.

Research into the characteristics and sources of atmospheric noise has been developed into a world-wide survey in co-operation with Australia and the United States of America. Sixteen service and commercial stations now make a schedule of hourly observations over the frequency band 2·5 to 20 Mc/s. The investigation is being extended to the low-frequency range of 15 to 500 kc/s.

The Australian Journal of Science

Vol. 13 21 June 1951 No. 6

The Department of Veterinary Physiology, University of Sydney

C. W. EMMENS*

THE Department of Veterinary Physiology occupies some 11,000 square feet of a two-storey temporary building near to the Ross Street entrance to the University grounds. Its layout is a compromise between the desirable and the unavoidable, as this portion of the building was already in existence prior to being taken over for its present purpose. The final result, however, has not been disappointing, and the Department is, for the most part, conveniently arranged. The main structural alterations and equipping were completed two years ago, and since that time the Department has been functioning full-time. Costs have largely been covered by grants generously provided by the Rural Bank of N.S.W., the Commonwealth Bank of Australia, the Australian Wool Industry Fund, and Messrs. Burroughs Wellcome & Co. Ltd. Contributions towards research and some staff salaries have also been received from the Wool Research Trust Fund, the George Aitken Pastoral Research Trust, the Australian Meat Board and the Commonwealth Research Grant.

The academic staff comprises the professor, two lecturers, and three full-time research workers. A visiting worker from C.S.I.R.O. was also present last year, and it is planned to accommodate three such workers in the near future. Technical and clerical staff and animal attendants total eight. Lectures and practical classes are given for third-year veterinary students, following a course in elementary physiology which is taken in common with medical and dental students in Year II. A substantial part of the time of the Department is thus devoted to research.

Layout and Services

A plan of the Department is shown in Figure 1. Not shown in the plan are three basement animal rooms and an attached store and washroom, and a new workshop at present in course of construction.

There are two large laboratories for classwork, each about 43 feet square, with attached preparation rooms and stores. The one on the ground floor is for mammalian physiology, while the one above is for more general physiological and biochemical work. Both of these laboratories are supplied with air exhaustion fans.

The mammalian physiology laboratory is equipped with twelve operating tables lit by fluorescent units and can accommodate sixty students. Each table is supplied with equipment for electrokymograph recording, electrical stimulation, heating of the animal and of saline; and with a pulsating air line for artificial respiration, to which is connected an anaesthetic-air mixer. Pulsations for time recording are sent out from a central clock, and each table has its own 6v. D.C. supply from which an induction coil is operated for regulating the strength and nature of electrical stimuli. Around the sides of the laboratory runs a bench with the usual services, including compressed air. This bench can be used for setting up preparations of isolated organs, or for haemoglobinometry, for example, in conjunction with animal experiments at the tables.

The general physiological laboratory has conventional benches, with the usual services plus vacuum lines, and can accommodate fifty students. It is well supplied with fume cupboards, refrigeration, incubators, ovens and furnaces, and has as an annex a balance room and a histological preparation room.

There are three research laboratories in operation and two in course of construction. Those now in use comprise two physiological laboratories, and one more biochemically-equipped laboratory. All have 240v. A.C., 6v. D.C., compressed air and vacuum lines; and two are arranged on a mutable plan, with two wall benches and some shelves as virtually the only fixtures. These (RL1 and RL2) have a central floor or ceiling service panel, so that a bench, operating table, or any other piece of equipment can be temporarily installed and removed when not required. The two new laboratories will be on a similar plan, and will have an annex for microscopy and histology.

The small animal rooms, three in number, cover an area of only about 650 square feet, the total space available for them. This is barely sufficient for present needs, and will be insufficient if the work of the Department requires more of the larger laboratory animals. At present, some 3000 mice, 250 rats, 50 rabbits and a few other species are kept. Work with farm animals has to be catered for elsewhere. These rooms are bare of permanent fitments except for electric points well above floor

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level, and can be cleared and washed down readily. They are served by an air inflow, thermostatically controlled at about 75°C, giving about four changes per hour. To avoid the distribution of effluent air into the rest of the building, it is drawn off by fans and discharged to the outside above roof level. The animals are housed in metal cages on metal racks and are fed cubed diets almost exclusively. A lift for the transport of animals runs up to each floor.

comparative aspects of animal physiology and particular attention is paid to species differences in digestion, metabolism and reproduction.

Practical classes are held twice weekly during Lent and Trinity Terms and occupy a total of at least 108 hours. One term is devoted to general physiology, mostly illustrative of points arising in the lectures, and the other to operative mammalian physiology with the rabbit as the subject. This latter course was initially based on the classes held in the Physiology

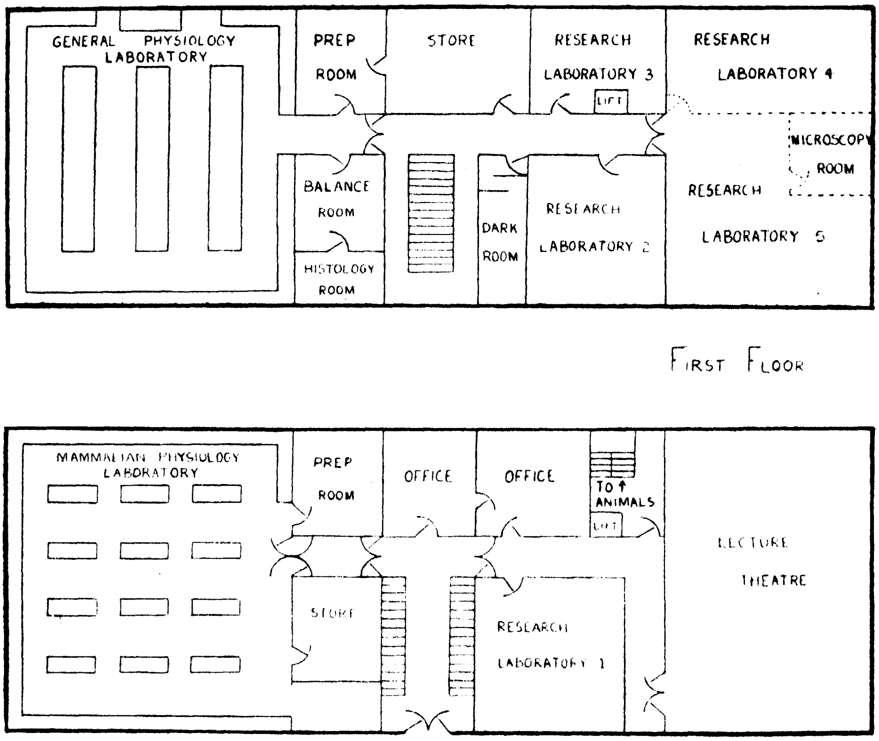

Figure 1

There were originally two lecture theatres, one on each floor, but the upper one is in process of conversion to the research laboratories mentioned above. Both are serviced by an air-circulation unit.

Lectures and Practical Classes

A course of about 60 lectures (Veterinary Physiology II), which assumes a knowledge of elementary physiology and biochemistry, is given during three terms. It covers assimilation, digestion, growth and metabolism, endocrinology, reproduction, and the nervous system, all with particular reference to domestic animals. In this course, stress is laid on the

Department of the University of Adelaide, under Professor Sir Stanton Hicks.

In the general physiology classes, students work in pairs or teams, according to the nature of the experiments. They use frogs, mice, rats, rabbits and sheep in practical studies of the physiology of anaesthesia, blood and circulation, reproduction and digestion. Commonly, the results of the whole class are designed to answer a particular question and to be an example of the scientific method in operation. These group experiments usually succeed, but when they fail there is a fruitful field for discussion which probably does more good than a series of unbroken successes.

The mammalian physiology classes are run as a series of teams, one to each operating table. The team, of four or five students, is divided into a surgeon, his assistant, an anaesthetist, a mechanic and a recorder. The duties of the last two are combined when the team is of four students only. All duties are undertaken in rotation, under the leadership of the surgeon. The practical work includes the recording of blood pressure and respiratory movements under various experimental conditions, studies of the effects of anaesthetics and other drugs, of haemorrhage and various measures designed to counteract it; measurements of blood volume, circulation time, the effect of drugs on diuresis; stimulation of various nerves and of the motor areas of the brain.

Research

At present, research is largely confined to reproductive physiology, both in males and females.

Various aspects of the physiology and biochemistry of mammalian spermatozoa are being studied. In this work, bull, ram, rabbit and human spermatozoa are used, with occasional diversions to other species—even to the honey bee. As a basis for other work, a comparative study was undertaken of the reactions of the various spermatozoa to such factors as variations in pH, osmotic pressure and the electrolytes present in artificial diluents. We started with observations of motility and percentage survival at various times from the start of tests, and are now progressing to manometric studies under similar conditions. Interest has also centred on reactions to temperature changes, in particular to low temperatures, as we have been experimenting with methods for preserving the semen of domestic animals by storage in the frozen state. This work, which received particular recent stimulus from the discovery of Polge, Smith and Parkes,* that spermatozoa may be successfully revived after relatively slow freezing, has met with success in the case of the ram and the bull, while the preservation of a percentage of rabbit spermatozoa has also been achieved. It remains to be seen whether such preserved semen is fertile. If it is, there is a strong possibility of storing semen for artificial insemination for many months or even years.

Another aspect of reproductive physiology which occupies us is the study of the capacity of both males and females to recover from sterility caused by the administration of oestrogens. This is a collaborative piece of work, designed as part of the programme of investigations into the sterility of sheep on Dwalganup early-subterranean clover, under the general organization of a C.S.I.R.O. Committee. All that we can say so far is that, although it seems likely that ewes are progressively sterilized by the seasonal intake of oestrogenic material in clover, we have not yet been able to imitate the condition in mice by the administration of crystalline oestrogens. Unless treated very early in life, and with results not resembling those seen in the sheep, the mouse seems to be able to recover completely. However, we are now investigating the effects of more prolonged, lower dosage, and of repeated dosage with rest intervals simulating a seasonal intake.

* *Veterinary Record*, 62, 115 (1950).

In part related to the problem of Dwalganup clover, but also forming a research programme in its own right, is an investigation into various aspects of the local (intravaginal) action of oestrogens in the mouse. This work originated in attempts to find a very sensitive method for the biological estimation of oestrogens in body fluids by the vaginal cornification technique, and to an extent this aim has been achieved. Thus, we can detect quantities of as little as 0·00005 μg per mouse, but the variability of responses is such that many animals are required for anything like an accurate assay. Attempts to reduce variability continue, as the method has the advantage that not only is it very sensitive, but it is not affected by esterification of the oestrogens tested, and the relative activities of the natural oestrogens are very much more alike than by any other test. Indeed, it seems likely that their potencies are identical when they are administered under optimal conditions, which avoid wastage of active material.

The greatest sensitivity in these intravaginal tests has been found when the oestrogens are linked to proteins, and the technique is also being used to determine which of the blood proteins show the greatest affinity for the hormones. A curious, and from one point of view a most irritating, discovery is that the more sensitive the test becomes the greater its variability, so that accurate measurement becomes very tedious. It is probable, however, that this observation is, in some way that we do not yet understand, fundamental to the investigation; and that if we discover why the variability in response increases we shall know very much more about the action of these hormones. With this in mind, we are looking into the differences between the effects of local and systemic dosage with oestrogens, and into the contributions that other endocrine organs may make to the process of vaginal cornification under the two conditions of administration.

In addition to the work on reproduction and sex hormones outlined above, other unrelated work has been undertaken. This includes a study of blood constituents during the course of the adaptation syndrome in sheep, and of the similarities and differences in the blood pictures of identical and fraternal twin cattle. The latter, although founded on only eight pairs of animals, has given rather startling results, in that no greater similarity has been found within identical pairs than within fraternal pairs of the same sex. This investigation covered blood cell counts, plasma chlorides,

blood sugar levels, and red cell fragility. The usual large differences were found between pairs, whether fraternal or identical, but there is no indication that these blood factors were more uniform in the identical than in the fraternal twins.

The Establishment of Coniferous Plantations in Australia*

N. Hall†

This article points out the place of coniferous wood in the timber economy of the world.

Reference is made to the shortage of 'softwoods' in Australia and the steps which the Commonwealth and States are taking to plan for the future by establishing coniferous plantations.

A review is given of the principal exotic and indigenous species used in plantations. Consideration is given to forest genetics and an outline of criteria in the selection of land for planting, preparation of the planting site, spacing and nursery and planting technique.

Introduction

The term 'softwood' has long been used to represent the wood of the Coniferae, of which the most important family is the Pinaceae. This group of plants is predominantly arborescent and includes such well known producers of commercial timber as the genera *Pinus* (pines), *Picea* (spruces), *Abies* (firs) and *Pseudotsuga* (Douglas fir).

The timber of the Coniferae is, in general, relatively light, of satisfactory strength in relation to weight, straight grained, moderately soft and easily sawn, machined and nailed. In contrast to this, hardwoods as a group, and particularly the genus Eucalyptus, are heavy, strong, not straight grained, hard and not readily hand-worked or nailed. Certain other properties, especially microscopic cell structure, result in softwoods seasoning much faster and more evenly than hardwoods. Because of these factors softwoods are more suitable for light building construction such as houses, for fittings, most furniture and the very large box and case industry. The Coniferae also produce the bulk of the world's pulp wood, and in most industrial countries, other than Australia, represent 80-90 per cent. of timber consumption.

* The second of a series of articles supplied through the Forestry and Timber Bureau (Commonwealth of Australia), 305 Collins Street, Melbourne, C.1.

† Division of Forest Resources and Timber Production, Forestry and Timber Bureau.

Compared with countries of the temperate regions in the northern hemisphere, the indigenous forest resources of Australia are markedly deficient in softwoods. A report presented to the Fifth Empire Forestry Conference in 1947 (Rodger, 1947) gave the following figures for the estimated total volume of timber in the exploitable forests of Australia:

	Million cu. ft. under bark	Per cent.
Softwoods	583	5·0
Hardwoods	11,406	95·0
Total	11,989	100·0

Contrasting with the small percentage of softwoods given for the volume of exploitable forests in Australia, is the high percentage consumption of softwood sawn timber. During the years prior to World War II, the figure was about 50 per cent. Recently this has fallen to 30-35 per cent., largely due to a smaller percentage of total consumption coming from the indigenous hoop pine.

Australia has none of the species of Coniferae common in the northern hemisphere, though it has some indigenous species of importance. The principal indigenous genus is *Araucaria* (hoop and bunya pines); next in importance is *Callitris* (cypress pines), and of still less importance is *Agathis* (kauri pines). Increasing in importance and already exceeding hoop pine in production are the exotic coniferous plantations. The most important exotic species is *Pinus radiata*.

The States have long been aware of the desirability of establishing coniferous plantations. Prior to World War I, some of the States had, over a long period, conducted planting on a small scale; and, following the war, planting programmes were developed which resulted in substantial areas being planted in the following twenty years. Following World War II, programmes were reviewed and, in most cases, substantially increased. The following table gives an indication of the current position:

Table I
Coniferous plantations in Australia as at 31 December 1949.

	Area Planted*		*Programme for total area by State Forest Services*
	State Forest Services	*Private*	
Qld.	40,000	—	200,000
N.S.W.	33,000	6,000	200,000
Vic.	49,000	13,000	200,000
S.A.	106,000	18,000	200,000
W.A.	13,000	—	100,000
Tas.	4,000	2,000	50,000
A.C.T.	16,000	—	40,000
	261,000	39,000	990,000

* All areas in acres to the nearest '000.

Queensland, New South Wales and Victoria each have target areas for annual planting programmes in the vicinity of 5000 acres, and in 1949 in one of these States this target was slightly exceeded. In South Australia the target has been 3000 acres for a long period, and between 1929 and 1949 that State established over 70,000 acres. Planting in Tasmania has been on a small scale up to the present time, but in 1949 it rose to approximately 700 acres, and future planting is planned on a larger scale. Western Australia had a pre-war annual planting programme of 1000 acres, and for the Australian Capital Territory the target is 500 acres per year.

Selection of Planting Country

Target areas for annual planting programmes by the State forest services total about 20,000 acres. The careful selection of land for such programmes is of considerable importance.

The large-scale selection of country for planting must give consideration to:

(a) Access to markets, present and future.

(b) Availability of sufficient area in one locality to make it possible for management costs to be kept within reasonable limits; and the ability to supply, on a permanent basis, local or other industries.

(c) Soil surveys should be carried out in any area which is considered for planting. The physical conditions can usually be assessed in the field adequately for conifers. Most pines prefer a light loam over clay at 2½-6 feet depth. A few species will grow on a rather tight soil, e.g., *Pinus canariensis*.

Relative topography and drainage are both important.

The chemical constitution of soils must be considered both for the major elements and for the minor elements. Of the major elements evidence accumulating during the past decade makes it increasingly apparent that many soils otherwise suitable for pines are deficient in phosphates (Boomsma, 1949). The application of commercial superphosphate may result in otherwise useless land supporting satisfactory forest.

The absence of one or more minor elements has been proved to result in unhealthy tree development (Kessell and Stoate, 1938). In Western Australia and South Australia the application of $ZnSO_4$ in aqueous solution to the foliage of young trees has resulted in markedly beneficial results under suitable conditions.

The natural vegetation of an area represents the effects of the factors of the site. Consequently, it must be taken into consideration in any assessment. It is rare for any one species of plant to be a complete guide for planting sites. Not only should indigenous tree species and their development be considered, but also ground cover—e.g. bracken fern. On heavy clay land, bracken fern is usually an indication of adequate surface soil drainage and in this respect is a positive indicator for conifers. On undulating, sandy country heavy bracken fern may be associated with the poorer, deeper sands and is then a negative indicator. In other words, bracken fern is mainly an indicator of drainage and soil aeration rather than of complete suitability of a site for the planting of exotic tree species.

Selection of Species

A wise selection of species is the foundation of successful plantation management. A species must be suitable for the climate, soil and topography of the planting site, and at the same time be capable of producing a grade of timber acceptable to industry.

The low rainfall of much of settled Australia, combined with the liability to drought and heat waves, has exerted a strong influence in selection of species for forestry purposes. Thus it has come about that species from the vicinity of the Mediterranean or of California have been most successful in the relatively dry winter-rainfall areas of southern Australia.

The outstanding species is *Pinus radiata*, a tree from California, where it was considered a very minor species.

The Woods and Forests Department of South Australia has an area of 95,000 acres in this species, representing approximately 90 per cent. of its area of coniferous plantations. *P. radiata* is also the most important species in Victoria, Tasmania and the south-west slopes of New South Wales.

At the present time, with the exception of Queensland, most of the coniferous plantations consist of exotic species of *Pinus*. Of the several indigenous conifers, two have proved satisfactory for use in large-scale establishment. These are *Araucaria cunninghamii* (hoop pine) and *A. bidwillii* (bunya pine). The former has been selected by the Queensland Forestry Department to be the principal species in its large afforestation programme. The Forestry Commission of New South Wales also plants hoop pine in the northern coastal districts. In Queensland, kauri is also planted, but because of difficulty in securing seed supplies it takes a minor place. *Callitris* spp. (cypress pines) are slow growing and are more suited to natural regeneration on an extensive scale than to intensive use in plantations. Of the remaining species of indigenous conifers, most belong to the Taxaceae, a family which presents many difficulties in large-scale plantation establishment.

Among species of pines from in or near the Mediterranean region, *P. pinaster*, the maritime pine of the extensive coastal plantations of Les Landes in south-west France, is the most important and is used on sandy sites too poor or marginal for *P. radiata*. *P. laricio* (Corsican

pine) and *P. canariensis* (Canary Island pine) are satisfactory under certain conditions, but are not planted to any great extent. *P. halepensis* (Aleppo pine) is only planted on a small scale. Two species from western U.S.A., additional to *Pinus radiata*, have been tried: *P. ponderosa* (western yellow pine) has a limited value for plantation use in Australia, whilst *P. muricata* (Bishop's pine) has been planted to some extent in South Australia, Victoria and New South Wales.

Among other genera of Coniferae, *Pseudotsuga douglasii* (Douglas fir) and two species of *Picea* (Norway and Sitka spruces) have shown promising results in restricted localities in Victoria and Tasmania. These useful species will not tolerate the low rainfall and heat under which many pines thrive in Australia and are consequently not likely to be planted extensively.

When planting was extended to the summer rainfall zone along the eastern seaboard north of Sydney, it was found that most of the preceding species were not suitable. This led to trials of species from other parts of the world with a comparable climate. From the subtropical south-east States of U.S.A. came *P. caribaea*, *P. taeda*, *P. echinata* and *P. palustris*. Of these, the first two are now well established as plantation species in Australia, especially from Coff's Harbour northwards to Gympie. *P. caribaea*, in particular, shows promise of being to the north what *P. radiata* is to the south. Another species which has shown promise, though on a small scale, is *P. patula*, a native of Mexico.

Genetics

Practice in overseas countries with forests which have been managed for hundreds of years shows that the selection of trees during thinnings, over many rotations, has tended to result in the final crop consisting of better form trees for any locality than otherwise would have been the case. In the initial establishment of plantations, however, it is of vital importance to ensure that good tree strains are used which will be satisfactory in growth, form and resistance to climatic damage and to disease.

During the earlier days of plantation establishment of exotics, seed was secured from various sources. Sometimes the seed was collected from trees of satisfactory form and vigour, but in other cases seed was apparently from any strain which was included by the botanists within a given species. One case is that of *P. ponderosa*, which, in its native habitat, is a magnificent tree exceeding 200 feet in height and yielding a useful timber. Seed planted in Australia and New Zealand forty to fifty years ago was just as likely to come from a stunted variety of no commercial value. There are several strains of *P. pinaster*, which between them show a great range in rate of growth and form.

Experience has led to greater care in securing tree seed and there has been a consequent improvement in the quality of the more recent plantations of these species. However, careful selection of seed from trees of good form in the forest guarantees only one of the parents and, in localities where there are more than one strain the resultant progeny from such seed collection may not be altogether satisfactory.

During the last two decades there has been an increasing interest in tree genetics by both Commonwealth and State forest authorities (Moulds, 1948). Investigative work has followed the lines both of controlled pollination and of vegetative reproduction. Progeny from the earliest experiments confirm overseas work and point the way to developing better strains for the forests of the future. The longer period taken for a tree to reach maturity makes the problem in the breeding of trees quite different from that in such crops as wheat, in which one generation is completed within a year.

For vegetative reproduction, cuttings are taken from young trees of selected form and set to develop roots in a nursery. The use of certain chemicals, such as various hormone preparations, materially increases the percentage of survival when cuttings are taken from older trees. There are two practical drawbacks to this method of approach. The first is that percentage of survival is best when taken from quite young trees—e.g., under six years of age—and less from mature trees in which form and development has found full expression. The second is that the cost of raising the hundreds of thousands of young plants necessary for large-scale commercial operations is still high compared with normal raising in a nursery from seed. In the opinion of the writer, though not agreed to by all foresters, the greatest immediate value in vegetative reproduction is in developing clones which can be used to establish seed 'orchards' with stud trees. This is a procedure which has found increasing favour overseas, especially in Sweden, where the earliest work on tree genetics was done.

To establish a seed 'orchard', cuttings from stud parents are planted at relatively wide spacings—e.g., 12 × 12 feet or greater—in order to allow of free cone development. Heavier cone development at an early age may be still further encouraged by 'shock' measures designed to stimulate fruiting buds rather than vegetative growth. Methods used include transplanting small trees and severe root pruning of larger specimens. It is important that these 'orchards' should be established sufficiently remote from plantations of the same or closely allied species so that there will not be any danger of pollen from undesirable male parents drifting down wind to the stud trees. By means of these 'orchards', seeds of known ancestry can be obtained with which to establish plantations.

The question of controlled pollination offers an even wider field in genetics, since pollination can not only be carried out between individuals of the same species but also of botanically closely allied species. Work on wheat and other agricultural plants shows that cross pollination has not uncommonly produced new varieties possessing more desirable features than those of either parent. Work on these lines is a long-term project, but one that is nevertheless of fundamental importance in forest research. For the short-term project, controlled pollination of parents within the same species offers means of rapid raising of seedlings for the establishment of seed 'orchards'.

Preparation of Planting Site

Planting sites require the soil to be in suitable physical condition with freedom from competition and protection from injurious animals and fire. The exotic conifers generally planted in Australia are strongly light-demanding, and although the indigenous hoop pine will tolerate shade, it also thrives best under conditions of full light.

It is customary to fell any woody growth on plantation sites six to twelve months before planting, and burn off in the last dry period prior to the commencement of the planting season. Protection against rabbits is carried out by fencing, which must be kept in repair for several years.

According to the type of soil, rooting habit of surface vegetation, and tree species to be planted, the planting sites may be dug prior to planting. In other cases line ploughing or mound ploughing (Casson, 1947) may be carried out, usually with tractors. Line ploughing is useful on areas where grass may interfere with the early growth of the young conifers, and mound ploughing is, as the name implies, ploughing into a mound so that the planting sites are several inches to a foot above the rest of the area. It is particularly suitable for flat sites liable to be wet during the rainy season.

Manure may be added prior to planting by placing a few ounces of manure at the planting site or by distribution with an agricultural machine.

Methods of Establishment

A plantation can be established by direct seeding on the plantation site or by the use of young trees raised in nurseries. Direct seeding, whilst offering some advantages, has many disadvantages under Australian conditions. The most common means of establishment is the use of seedlings 6-12 inches high. For *P. radiata* and *P. caribaea*, this size would represent stock less than twelve months old. With some species and on sites unfavourable for early tree growth —e.g., where there is heavy competing bracken fern—two-year seedlings or transplants may be used.

Most of the exotic conifers, other than *P. canariensis* and *P. patula*, readily transplant bare-rooted. With *P. canariensis* direct seeding has been satisfactory, and with *P. patula* tubed stock has been used. The latter method is also standard practice with the indigenous hoop pine. When young trees do not transplant satisfactorily bare rooted, use may be made of planting tubes. These tubes can be of various materials from wood veneer to metal. A type that is commonly used in Australia for hoop pine consists of a piece of thin metal 8 inches deep and sufficiently wide to bend into a tube about 2 inches in diameter. After the seed has germinated and the small seedlings are sufficiently large to handle, they are placed into the tubes, which have been filled with nursery loam. The tubes are put alongside one another in the nursery and are shifted to the plantation when the seedlings are sufficiently large. The tubed seedling is placed in its final site in the plantation and the tube is then withdrawn for return to the nursery.

Spacing of Plants

Spacing should vary with the species, purpose for which the final crop is to be used, markets available for small thinnings, and quality of the soil. Close spacing results in slower diameter growth of the individual trees, but provides a greater quantity of small-sized timber in early thinnings, reduces the size of the knots in the timber and, very important, offers scope during thinnings for the selection of the best trees to form the final crop. On the debit side is the increased cost of close spacing compared with wide spacing. No arbitrary rules can be laid down for spacing but each problem must be decided on the factors involved.

Most European forests are established by natural regeneration, but where planting is resorted to, spacing has usually been within the limits of 3×3 feet and 6×6 feet.

Early Australian practice tended to follow European standards; but for various reasons, particularly lack of markets for small-size thinnings, spacing became wider, until in the depression years of the early thirties, plantations were established at the unduly wide spacings of 10×10 feet and 12×12 feet. Nowadays most conifers are planted from 7×7 feet to 8×9 feet.

Market conditions, both present and future, are of vital importance when considering spacing. Case makers in Australia have found that small-sized coniferous thinnings are more satisfactory than second-class hardwoods. This fact, together with the development of the pulp and paper industry, has been of basic importance in enabling profitable early thinnings to be carried out in plantations. The desired size and quality of the final crop, as well as the thinning technique it is proposed to adopt, must also influence original spacing.

Nursery Practice

Nursery sites are usually selected close to principal planting locations in preference to remote larger nurseries. Very gentle slopes, sheltered, with good natural drainage and consisting of moderately fertile sandy loam, are most suitable. Seed is usually sown in early spring in drills which are from 8 to 14 inches apart. Density of the seeds, with many species, is calculated to give 12 to 20 seedlings to the lineal foot. Watering is not a standard practice, though it is carried out in certain areas which have dry spells in the spring when the seed should be germinating. Rapid and effective germination may be assisted by pretreatment of the seed immediately prior to planting. Methods used include stratification, cold storage and chemical treatment. Weeding of the nursery site is usually a major item of cost in nursery operations, and though mechanical means are used there is always a considerable amount of hand labour, especially in the early stages of seedling development. Chemicals have been used for weed control, but not always with complete success.

It is customary with most species, as the seedlings approach planting size, to sever the tap root in order to encourage good lateral development and harden off the seedlings prior to transference to the plantation.

Seedlings may be held over a second year in the nursery in their original positions. They are then known as 'two-year seedlings'. If they are transplanted into new positions in the nursery they then become 'transplants'.

When required in the field the plants are lifted and done up in bundles, usually of 50 to 100 if one-year seedlings. They may be 'puddled'—i.e., the roots of the bundles dipped in a liquid clayey mixture to protect them from too rapid drying—whilst being handled between nursery and actual planting.

Planting technique

Planting may be carried out with spades, mattocks or special planting dibbers. The tool used will vary with the type of soil and preference of the local foresters. Young trees are carried by the planters in boxes or bags designed to protect the roots from exposure. Rates per man-day may vary from several hundred to a thousand. Planting machines have not been used to any extent in Australia. Probably the main reason for this has been that planting has been mainly carried out on country which has the stumps and logs of indigenous trees on it, and offers too many obstructions. The Forests Department of Western Australia has used a planting machine, and a private company in New South Wales has imported a U.S.A. beet planter and adapted it to local requirements.

Tending After Planting

Care of the young trees immediately after planting and until canopy is established is usually considered to be part of establishment. This includes protection against rabbits and other natural enemies, removal of native vegetation which threatens the young plants before they can raise their heads above it, possibly 'form' pruning to control early development of double leaders, etc., and a watch on the health of the plantations with respect to insects and disease.

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British Commonwealth of Nations Scientific Liaison Offices

UNDER the above title, abbreviated for common use to B.C.S.O. (London), the Scientific Liaison Offices of the various countries of the British Commonwealth have grouped themselves in a joint headquarters in Africa House, Kingsway, London, W.C.2, where they can be approached through a common telephone exchange (HOLborn 3422). Such an arrangement was recommended by the British Commonwealth Scientific Official Conference held in London in 1946, based largely on the successful operation of a similar scheme, during and since the war, in Washington, D.C., under the title of B.C.S.O. (North America).

Several of the Commonwealth countries have maintained scientific liaison offices in London for a number of years, New Zealand being the pioneer, its office having been in existence since 1928. The establishment of the joint headquarters has not affected the independent nature of the several offices, which continue to operate separately as in the past. It has been found, however, that the convenience of occupying adjacent premises facilitates informal exchange of views and co-operation on matters of common interest. The heads of the different

scientific liaison offices participating in the scheme form a small House Committee which controls the general running of the Common Services Section, manned by staff seconded to B.C.S.O. (London) from the U.K. Department of Scientific and Industrial Research. The cost of Common Services is shared between the different Commonwealth countries in agreed proportions. Apart from such routine common services as messengers, reproduction of documents, etc., a number of joint projects are undertaken. Some of these were assigned to B.C.S.O. (London) by the British Commonwealth Scientific Official Conference, 1946, including responsibility for the secretariat of the Standing Committee and Working Party set up by this Conference. Examples of other joint projects are the organization and publication of Directories and Lists of Culture Collections of Micro-organisms within the Commonwealth, the preparation and maintenance of lists of translations of scientific papers available in the various countries, lists of post-graduate scholarships available within the Commonwealth.

Apart from B.C.S.O.'s responsibility for the secretariat of the Standing Committee and Working Party set up by the 1946 Conference, which is undertaken by the Common Services Section, the heads of the various Commonwealth scientific liaison offices act as their countries' representatives on the Working Party and on related committees responsible either for organizing 'specialist conferences' or for implementing their recommendations. These specialist conferences arose from discussions at the 1946 Conference covering a wide range of topics on which it was realized that more detailed consideration was desirable with a view to evolving possible schemes for Commonwealth collaboration in research. So far five such conferences have been held on the following subjects:

(1) Culture Collections of Micro-organisms: London, August 1947.

(2) Radio Research: London, August 1948.

(3) Geology and Mineral Resources: London, September 1948.

(4) Plant and Animal Nutrition in Relation to Soil and Climatic Factors: Australia, August/September 1949.

(5) Fuel Research: London, July 1950.

It will be seen from the foregoing that one of the most important aims of B.C.S.O. (London) is to further Commonwealth co-operation in research using the mechanism provided by the 1946 Conference. Another important function of B.C.S.O. (London) is to serve as the headquarters for Commonwealth scientists visiting the United Kingdom. Office accommodation is provided for such visitors in Africa House, and so far as possible stenographic assistance is also given, in addition to arrangement of itineraries, hotel bookings, etc., by individual offices. In order to make their presence known to scientists in the United Kingdom who may wish to get in touch with them, monthly lists of these visitors are circulated to interested Government departments, learned societies, etc. Extracts from these lists are on occasion published in scientific journals in order to bring the news of the presence of individual specialists to the notice of United Kingdom scientists working in similar fields.

Although B.C.S.O. (London) has been in existence for less than three years, it is already becoming recognized as the focal point of Commonwealth government scientific activities in the United Kingdom. Its Conference Room, originally intended for Working Party meetings and Specialist Conferences, is made available on occasion for meetings of other Commonwealth organizations of a scientific nature. United Kingdom research and industrial organizations are increasingly finding it convenient to approach the Commonwealth scientific liaison offices collectively through B.C.S.O.

Quite apart, however, from the combined activities outlined above, each Commonwealth scientific liaison officer has a more or less well-defined sphere of action, which varies according to the country; including representation on official scientific committees (either as members or observers), exchange of information regarding scientific developments in his own country and in the United Kingdom, and answering enquiries on specific technical questions.

At present the Chief Scientific Liaison Officers of the overseas Commonwealth countries are as follows:

Canada: Dr. J. G. Malloch.

Australia: Mr. J. E. Cummins.

New Zealand: Dr. E. Marsden.

South Africa: Mr. J. P. de Wit.

Central Africa: Dr. G. R. Bates.

India: Dr. S. Krishna.

There is in addition a United Kingdom Scientific Liaison Officer (Dr. T. C. Marwick), who forms a link with Government departments. The Overseas Liaison Division of D.S.I.R. is also located in Africa House. Although Pakistan and Ceylon have not yet appointed Scientific Liaison Officers, they are both members of the Standing Committee and participate in the activities of B.C.S.O. (London).

Through the Standing Committee and Working Party set up by the 1946 Conference, preliminary discussions are taking place regarding plans for the next Commonwealth Scientific Conference to be held in Australia early in 1952, for which invitations have been issued by the Australian Government. This Conference will review action taken to implement the recommendations of the 1946 Conference and will also consider new proposals for collaboration in research.

The Science and Industry Endowment Fund

A FUND to provide assistance to persons engaged in scientific research and in the training of students in scientific research was established by the *Science and Industry Endowment Act* passed by the Commonwealth Parliament in 1926. By that Act a sum of £100,000 was appropriated out of the Consolidated Revenue Fund, and the income from this amount forms the 'Science and Industry Endowment Fund'.

The Fund was vested in and placed under the control of trustees, who in the first instance were the members of the Executive Committee of the Council for Scientific and Industrial Research and now are members of the Executive of the Commonwealth Scientific and Industrial Research Organization.

In 1926, lack of trained scientific workers was one of the main obstacles to scientific research in Australia and the trustees were of the opinion that most of the income should be spent in providing assistance for training Australian students overseas. Accordingly a number of research studentships were established for distinguished honours graduates who had proved that they were capable of taking full advantage of an opportunity for intensive training in scientific research. Since that time 103 students have been awarded studentships. In six cases, however, a Junior Research Studentship was followed by a Senior Research Studentship, so that the total number of personnel who have been awarded studentships is 97. Of this number, 41 former students are at present employed by C.S.I.R.O. and seven studentships are current.

The pressing need to send students abroad for training gradually diminished, in part due to the inauguration of other traineeship schemes, and further money was freed for the other main object of the Fund—i.e., to provide assistance to people engaged in scientific research. Since 1926 the total expenditure incurred in this connexion is £22,954.

The trustees followed the lines which had been proved satisfactory by the British Department of Scientific and Industrial Research, and invited applications for grants for any of the three following objects:

(i) to provide personal payments to investigators to enable them to give whole or part time to a research conducted independently or in collaboration with a professor or person interested in the development of such research;

(ii) to provide laboratory, clerical, or other assistance to persons engaged in research; and

(iii) to provide grants for special equipment and other special expenses incidental to research.

In considering applications for assistance, the trustees do not entertain applications when, in their opinion, such asistance should be provided by existing institutions. Thus, except in exceptional circumstances, they are disinclined to consider applications for personal payments to members of the staffs of universities or other institutions having research as one of their functions. They hold, with the British Advisory Council, that 'research, no less than teaching, is a primary function of these institutions, and the salaries attaching to posts on their staffs ought to be sufficient to enable the holders to devote a reasonable proportion of their time to the advancement of knowledge within their respective departments'. Nor do they provide technical or clerical assistance of a general kind in a research laboratory, or apparatus which should be part of the normal equipment of a laboratory used for teaching purposes.

Grants for financial assistance to research workers are now available from this Fund, and applications or requests for further information should be addressed to the Secretary to the Trustees, Science and Industry Endowment Fund, c.o. C.S.I.R.O., 314 Albert Street, East Melbourne, C.2, Victoria.

The International Society of Soil Science

THE first International Society of Soil Science was inaugurated following an International Soil Science Congress in Rome in 1924. It continued in an active state for fifteen years and conducted three further international conferences but disintegrated finally early in World War II. By mutual agreement the Fourth International Soil Science Congress, at which 32 countries were represented, was held in Amsterdam in July 1950. Arising from discussions during the Congress, an entirely new organization was set up, based largely on the principles and rules of the old body.

The new society is open to soil scientists of all nations without discrimination. It is managed by an Executive consisting of the President, Vice-President, Past President, Secretary and Chairman of Commissions, and by a Council consisting of the Executive and representatives of National Societies with seven additional representatives of members not attached to Societies. The latter are on a geographic basis: North Europe, South Europe, Asia (2), Australia and New Zealand, Africa and Latin America.

The scientific work of the Society is divided between six commissions: 1. Soil Physics, 2. Soil Chemistry, 3. Soil Biology, 4. Soil Fertility and Plant Nutrition, 5. Soil Genesis and Classification (Morphology, Cartography and Geo-

graphy), 6. Soil Technology (Erosion Control, Drainage, Irrigation and Tillage). Other commissions may be set up by the Council.

A Congress is to be held not less than once in five years. On the invitation of the Belgian Government the next is set down for Leopoldville, Belgian Congo, in 1954. The aim of this is to direct the attention of the whole body of soil scientists to problems of soils occurring in tropical regions, with the provision for suitable field excursions. It has been proposed to hold a meeting of the Fourth Commission on Soil Fertility in Eire in 1953.

A bulletin is to be issued four times a year by the Secretariat, giving details of the Society's activities, programmes of Commissions, and personal matters for members. General articles on research organizations may be included, but not any research paper which distinguishes it from the journal of the old society.

The membership fee is $1 (U.S.) or equivalent, which entitles the member to all notices and the bulletin. The Secretary-General is Dr. W. R. Domingo, Bedrijfslaboratorium voor Grondonderzoek, Mariendaal, Oosterbeek, Netherlands.

Pacific Oceanography

THE Council of Scientific and Industrial Research in New Zealand has constituted an Oceanographic Committee. The functions of the Committe are: (1) To co-ordinate, correlate and assist oceanographical work in New Zealand and to sponsor research projects and the publication of results thereof through existing journals; (2) to act as the national organization in oceanography with respect to overseas and international organizations; (3) to advise the government through the Council of Scientific and Industrial Research, and the defence authorities through the Defence Science Secretariat, on oceanographical matters; (4) to provide for the servicing and distribution of oceanographic data and materials from H.M.N.Z.S. *Lachlan* and other sources.

A. W. B. Powell, member of the Pacific Science Association Standing Committee on Pacific Oceanography, is chairman of the Committee, and J. W. Brodie, Department of Scientific and Industrial Research, Wellington, is secretary. The Committee is made up of representatives of the Museums, University, Royal New Zealand Navy, Marine Department, Meteorological Office, and Department of Scientific and Industrial Research.

The Geophysical Laboratory, Wellington, reports the installation in 1950 of an Admiralty wave recorder in 45 feet of water near Greymouth (West Coast, South Island) and of a frequency analyser in Wellington. Wave records began in August 1950. A programme of sea-temperature measurements is being conducted around New Zealand, partly by ordinary bucket and thermometer and partly by recording thermographs, two of which have been obtained for the frigates which normally cover the waters around New Zealand, up to the South Pacific islands and to Australia. The Meteorological Office has installed one on the *Monowai*, going to and fro across the Tasman Sea, and two others are being placed on other merchant ships. An insulated water sampler for deeper waters, and three bathythermographs, have arrived from U.S.A.

The H.M.N.Z.S. *Lachlan* recommenced the hydrographic survey of the New Zealand coasts early in 1950 and is collecting water, bottom, and plankton samples, as well as temperature, tidal, and current observations. It i. expected that *Discovery II* and *Galathea* visits to New Zealand waters, in 1950 and 1951 respectively, will yield much data.

The Geophysical Observatory is also working on a small scale on such subjects as: (1) Variations of tidal phase-differences between various points in Cook Strait; (2) Sea-level oscillations of periods intermediate between waves and tides; (3) Earth potential effects from off-shore tidal currents (lunar semi-diurnal oscillations are found on the records at several places on the coasts); (4) Relations of local microseisms to wave and weather conditions at Wellington, and also the incidence of microseisms at Suva and Apia with development of tropical storms; (5) Refraction and other features of surf on local coasts.

Marine-geological work by H.M.N.Z.S. *Lachlan* is hampered by the ship's inability to remain stationary, but 12 small samples from an area between Bluff and Ruapuke are now being studied by (1) mechanical analysis, (2) micro-faunal analysis, (3) mineralogical analysis. Mapping of non-depositional areas and sampling of rock bottom require special gear and are difficult, but are under consideration. In 1951 there may be opportunities to collect rock samples from the less accessible islets of Foveaux Strait. At the request of the Marine Department a survey was made of Mernoo Bank, a seamount rising to 28 fathoms from depths in excess of 300 fathoms some 110 miles ENE of Banks Peninsula. A fathomgram trace between the Mernoo Bank and Lyttleton shows an abrupt scarp, 120 feet high, breaking the gentle slope of the sea bottom in 250 fathoms.

At the request of the N.Z. Geological Survey, the H.M.N.Z.S. *Tutira* ran soundings from Stewart Island to Snares, to Auckland Island, to Macquarie Island, to Campbell Island, to New Zealand; and H.M.N.Z.S. *Pukaki* sounded two separate runs between North Island and Campbell Island and from Hauraki Gulf to Kermadec Islands in April, 1950. Additional runs will help to fill notable gaps in the chart, and will test interpretations of the form of the sea floor near New Zealand.

* Information supplied through the Pacific Science Council

Oceanography in Japan

Oceanographic observations in seas adjacent to Japan are now being made, under the control of the occupation forces, by the surveying ships of the Hydrographic Department, Maritime Safety Agency, Tokyo; eight Fisheries Institutes; and the Central Meteorological Observatory, Tokyo, including its four subordinate marine observatories and some local agencies subordinate to them. The elements observed range over almost all branches of physical, chemical, biological and geological oceanography. Activities were curtailed by World War II, but they are now rapidly recovering. The facilities and the apparatus are so inadequate, however, that the observations are mostly confined to the layer shallower than 1000 to 1500 metres. Neither a single model of bathythermograph nor a single ship equipped with Loran can be found in Japan; so that it is not yet possible to extend observations to all layers from the surface down to the ocean floor, or to catch the instantaneous states of the oceanic phenomena with great accuracy.

The organizations responsible for oceanographic research are divided into three groups:

(1) The Hydrographic Department, Maritime Safety Agency, Tokyo;

(2) The Tokyo and seven other Fisheries Institutes distributed throughout the country;

(3) The Meteorological Observatory, Tokyo, and subordinate Marine Observatories at Hakodate, Kobe, Maizuru and Nagasaki, and some coastal meteorological stations.

The research of these three groups is reported in detail in *Supplementary Bulletin* RS/51/1, issued by the Pacific Science Council Secretariat, Bishop Museum, Honolulu 17, Hawaii.

A Report on Atomic Bombing*

G. H. BRIGGS

MODERN air power has made isolation no longer a defence against devastating air attack. The United States is very conscious of the fact that atomic weapons could do great damage to its cities and industries.

Fourteen months after Hiroshima, the U.S. War Department set up a Civil Defence Board to study the effect of atomic bombing, and early in 1949 the National Security Resources Board was given the primary responsibility for the planning of civil defence against atomic attack on the United States.

During 1949 and 1950 a number of U.S. Government reports on various aspects of atomic warfare were made public. *The Effects of Atomic Weapons* was originally published in 1950 as a U.S. Government report. In its present form it is likely to have a wider circulation. It was prepared by groups of experts in co-operation with the Department of Defence and the Atomic Energy Commission and it is commended by the Civil Defence Office of the National Security Resources Board as a source of scientific information for technical personnel engaged in civil defence planning. It is a sad commentary on world affairs that it is necessary to compile technical data on atomic bombing and make it readily available, together with the scientific background, so that there can be an intelligent understanding of the effects of atomic bombs on cities and their inhabitants.

The book is not written for the layman but for those with a scientific or technical training. It deals strictly with quantitative phenomena. The more general aspects of the problem, which includes political, social and financial matters, have been discussed elsewhere. Thus, for example, the *Bulletin of Atomic Scientists* devoted a special issue (August-September 1950) to 'Civil Defence against Atomic Attack'. That issue also contains a useful bibliography on the subject.

There seems to be little doubt that the hearings early in 1950 before the U.S. Joint Congressional Committee on Atomic Energy, at which witnesses stressed the need for the release of information about the dangers to be faced in atomic attack, contributed to the early publication of this book. However much one may deplore the need to set up civilian defences against atomic attack, one can appreciate the value of the intensely practical approach to the problem being made in the United States, whose Federal Government, through the Federal Civil Defence Act of 1950, is co-ordinating the work of the various States and providing finance on an equal basis.

The book discusses quantitatively the effect on structures and personnel of blast, thermal and nuclear radiation, incendiary action and radioactive contamination. It deals with air bursts, under-water and underground bursts; taking as a basis for discussion a nominal atomic bomb equivalent in energy release to 20,000 tons of TNT—i.e., an energy release of 2×10^{13} calories, or from the complete fission of approximately one kilogram of Uranium-235 or Plutonium-239. The treatment of the various topics is thorough. The necessary scientific and technical background of the various physical processes is given and this is then applied to the consideration of typical examples. Of necessity the discussion of blast effects depends to some extent on extrapolation from types of explosion amenable to experimental observation, but a good deal of verification of theory has been possible by comparison with the controlled bursts in the Pacific.

* THE EFFECTS OF ATOMIC WEAPONS. Edited by Samuel Glasstone. (New York: McGraw-Hill, 1950. 456 pp., numerous text-figs. and tables, 6 appendices. 6″ × 9½″.) Price, $3.00.

A case of particular importance to the Australian State capitals is the shallow under-water burst. The treatment of this is based on the Bikini under-water burst in which a 5 m.p.h. wind was blowing. The calculations indicate that over an area of ten square miles unprotected persons present at the time of the burst would suffer severe injury due to dispersed radioactivity. The rate of decay of the radioactivity, however, would be comparatively rapid.

To those concerned with the actual planning of a country's defences against atomic attack, this book will provide a most valuable account of the basic technical facts and scientific theory.

A Theory in Energy Mechanics*

SIR KERR GRANT

IN this book the author, who is an Assistant Professor of Mechanics in the Georgia Institute of Technology, purports to set forth the fundamentals of a new system of relativistic mechanics in which stress is laid upon the dynamical or, as he calls it, the 'energical' aspect of relative motion rather than upon the kinematical relations which form the basis of Einstein's theory of special relativity. He believes that he is thus able to avoid the epistemological difficulties associated with the idea of a variable time-scale—i.e., of identical clocks having different rates—and with the association of space and time involved in Minkowski's four-dimensional space-time continuum.

He accepts the first of the two postulates on which Einstein based his theory, namely that a state of rest and one of uniform relative motion are indistinguishable by virtue of any effect in physical phenomena (in particular that the motion of the Earth through space produces no observable effect), but he rejects his second, viz., that the velocity of light is the same in all systems of reference which have uniform relative motion (so-called 'inertial systems').

To justify this latter heresy he points out, correctly, that in the basic invariant equation for the propagation of light ($x^2 + y^2 + z^2 = c^2t^2$) as in all other electromagnetic relations, it is invariably the product $c \times t$ which occurs, never c alone or t alone. (This fact, of course, is basic in Minkowski's conception of unified 'space-time'.) Hence he proposes to make the variation in the product necessary to preserve the said invariance when the inertial system in which x, y and z are measured is changed, by allowing c to vary and t to remain the same, rather than by the accepted converse assumption.

For systems S_0, S_1, etc., in relative motion with velocities v_0, v_1, etc., and denoting the velocity of light in these by c_0, c_1, etc., the basic equation then gives $x_0^2 - c_0^2t^2 = x_1^2 - c_1^2t_1^2 =$ etc. If, as Mandelker assumes, $t_0 = t_1 =$ etc. $= t$, then: $c_0^2 - v_0^2 = c_1^2 - v_1^2 =$ etc.; or, briefly, $c^2 - v^2$ is invariant from system to system. Now this invariance already raises a problem which Mandelker chooses to ignore. It implies, obviously, that the velocity of light is greater, the greater the velocity of the system of reference in which it is measured, whether this motion be in the same or in the opposite direction to that of the ray of light! However, let it pass for the time.

A second difficulty of interpretation arises in deciding in which system the velocity of light has the value (3×10^{10} cm/sec) given both by direct measurement and by electromagnetic theory. On this point Mandelker is also silent, although by inference it is that system in which the source of light is fixed. Nevertheless, he puts $x_n = 0$ and also $v_n = 0$ in the nth system, in which the 'ray point'—not the source—is at the origin and at rest (apparently deriving the value 0 for v on the zero value for x) and bases much future calculation on this choice. If, for brevity, we use the conventional β for $1/\sqrt{1-v^2/c^2}$, then the velocities of light in the different systems of reference are related by the equations:

$$c_0/\beta_0 = c_1/\beta_1 = \ldots\ldots\ldots c_n.$$

Proceeding now to the dynamical aspect of his theory, he first introduces the idea of 'matter-momentum' (mc) as a counter-part of 'matter-energy' mc^2 ('Mass' would perhaps be preferable to 'matter'.) Accepting the relation of the mass (m) in a system in motion to that of the 'rest-mass' (m_0) in a system in which it is at rest ($m = m_0\beta$), he claims to establish a 'law of conservation of matter-momentum' (mc invariant). His 'proof' applies only to the equality of m_nc_n and m_0c_0, but complete generality is claimed. Let us test this claim.

For any system (m, c, v) we may write, taking S_0 as our 'rest system' ($v_0 = 0$), $m = m_0\beta$; $c/\beta = c_0$ (from $c^2 = c^2 - v^2$). Hence $mc = \beta^2m_0c_0 = m_0c_0(1 - v^2/c^2_0)$, and $mc = m_0c_0$. The fallacy in Mandelker's proof lies in his postulate of a zero-velocity in the nth system, as well as in that in which the velocity of light is c_0.

Another flagrant error lies in the attempt to prove that the Lorentz-Einstein transformation equations $x' = (x-vt).\beta$, $t' = (t-vx/c^2).\beta$ are still correct, with his assumption that $t = t'$. It is easily shown, however, that with this change $x^2 - c^2t^2$ is no longer invariant.

His discussion of relativity energetics is based on Einstein's equation: $E = mc^2$. He insists that energy, not mass, should be

* PRINCIPLES OF A NEW ENERGY MECHANICS. By J. Mandelker. (New York: Philosophical Library, 1950. 73 pp., 17 text-figs. 9⅛" × 5⅞".) Price, \$3.75.

regarded as the basic physical reality, and he also postulates that mass-energy should be regarded as potential energy and that total energy is the sum of this mass-energy plus the kinetic energy of the relative motion.

His expression for the kinetic energy differs from that which was first given by Einstein, viz. $E = m_0c^2(\beta - 1)$, but is the same as the later derivations, viz. $E_k = m_0c^2(1 - 1/\beta)$. His value for the intrinsic mass-energy, m_0c^2/β, makes the sum of the two equal to the mass-energy in a state of rest. This result has an attractive parallelism to the law in non-relativistic mechanics.

Mandelker makes an interesting application of his energetic theory to the problem of wave-corpuscle duality. The kinetic energy is assigned to the wave-aspect, the potential or intrinsic mass-energy to the corpuscular. Thus when $v = c$, $E_k = m_0c^2$ is the measure of the quantum of energy $\times$ frequency, and when $v = 0$, $E_k = 0$, and we are dealing with a stationary corpuscle of the same energy, but now intrinsic.

In his last chapter, entitled 'Schrödinger's Wave Equation: The Question of the Half-quantum', Mandelker's attempt to justify the 'half-quantum' or 'zero-point' energy as a consequence of his energy-formula appears misdirected. For, in Schrödinger's solution of the problem of the linear oscillator, all possible energy values are given by the formula $E = (2_n + 1).\frac{1}{2}h\nu$, from which $E = \frac{1}{2}h\nu$ for $n = 0$.

It may be that a more explicit and revised statement of the points which this reviewer has criticized might remove certain difficulties and show some of them to be due to misinterpretation. Even so, in the reviewer's opinion, the logic of Einstein's discussion of simultaneity in time and consequent relativity of time-intervals in different inertial systems would remain untouched and must in some way be reconciled with whatever is sound in Mandelker's theory before the latter can hope to gain respect and acceptance. As it stands, the theory is untenable, and the best that can be said for it is what probably can be said of any theory, however bad: 'There may be something in it'.

Nuffield Fellowship Awards

The Australian Advisory Committee of the Nuffield Foundation has announced the award of six Dominion Travelling Fellowships to the following research workers, enabling them to spend twelve months on research in the United Kingdom. The Committee found no applicant in the field of humanities of sufficient standard to make an award in that field as it was able to do in the fields of natural science and social science.

S. J. Angyal (36) took the degree of Doctor of Philosophy in the University of Budapest in 1937. In 1936 he was appointed lecturer in Organic Chemistry in the University of Sydney, which position he still holds. He is particularly interested in the chemistry of inositols, sugar-like compounds of great biological interest, and he hopes to continue his researches under Professor A. R. Todd in Cambridge.

J. F. Cairns (36) graduated in Commerce in the University of Melbourne in 1947, and took a Master's degree in 1950. Most of his course, in which he achieved first-class results, was taken part-time while he was serving in the Criminal Investigation Branch of the Victorian Police Force. His promise as a scholar and teacher led to his appointment as tutor and later as lecturer in Economic History in the University. Mr. Cairns will study English influences in Australian economic history in the nineteenth and twentieth centuries, especially in relation to the labour movement.

G. S. Christie (34) went to the University of Melbourne from Scotch College in 1936, and graduated in medicine in 1941. After residence at the Royal Melbourne Hospital, he spent over four years in the Australian Army Medical Corps, serving in Darwin, New Guinea and Bougainville. He then returned for a short time to the Royal Melbourne Hospital, and in 1947 became lecturer in Pathology in the University, as well as Assistant Pathologist to the hospital. Dr. Christie hopes to study pathological techniques under Professor G. R. Cameron in the University College Medical School, London, and to visit other centres of pathological research in Great Britain.

K. W. Cleland (28) graduated in Medicine in the University of Sydney in 1945 and shortly afterwards was appointed lecturer in Cytology. He will pursue his researches into the fundamental nature and operation of living tissues, to which field he has already made significant contributions. Dr. Cleland is already in London.

Bryan Hudson (27) graduated in Medicine in the University of Melbourne at the top of his year in 1946. He was resident after graduation at the Alfred Hospital, and in 1948 became clinical supervisor of medical students training there. In 1949-1950 Dr. Hudson worked as Fellow in Pathology at the Northwestern Medical School, Chicago, and he is now working with Professor G. W. Pickering, Director of the Medical Unit at St. Mary's Hospital, London, on the operation of the new drug cortisone. Dr. Hudson will continue his present work under his fellowship, and will also make a study of methods used in training medical students in the United Kingdom.

H. P. Sullivan (34), M.D.S., of Sydney, is the first graduate in Dental Science to receive an award. He completed his course in 1938 and worked as a research officer in the Bacteriology Department of the University of Sydney until he enlisted in the A.I.F. In 1949 he was appointed assistant director of the Institute of Dental Research. He intends to use his fellowship to study the biochemical aspects of calcified tissues.

The Australian National Research Council

Delegates

THE following have been appointed to represent the A.N.R.C. at various international meetings:

- E. G. Bowen at the Mixed Commission on Radio-Meteorology, General Assembly of the International Union of Pure and Applied Physics;
- Associate-Professor E. O. Hercus at the General Assembly of the International Union of Pure and Applied Physics;
- A. R. Hogg at the General Assembly of the International Union of Geodesy and Geophysics;
- J. M. Rayner to be leader of the Australian delegation to the General Assembly of the International Union of Geodesy and Geophysics;
- R. W. Kerr at the International Congress of Entomology.

Honorary Treasurer

Associate Professor W. A. Rawlinson has been appointed Acting Treasurer during the absence abroad of Professor V. M. Trikojus.

Imported Microscopes

The A.N.R.C. has supported the University of Melbourne in its request that the duty on imported microscopes be not increased.

Thomas Ranken Lyle Medals

The A.N.R.C. endorsed the recommendations of the special committee that the following be the awards:

- 1949 Award: Professor K. E. Bullen, University of Sydney, for his work in geophysics and seismology;
- 1951 Award: Professor T. M. Cherry, University of Melbourne, for his work on the mathematical theory of the flow of gases.

Journals

The cost of printing has risen to such an extent that additional funds will be needed to finance the Council's journals. The Executive Committee considers that the Australian Government should be approached for an additional grant for *Oceania*. Draft terms of reference have been drawn up for the Committee of the *Australian Journal of Science* and provision has been made for a more ample staff and for the appointment of active State representatives. Terms have been agreed upon for continuance of *Australian Science Abstracts*. The needs of the *Journal* and the *Abstracts* were set down for special attention by the General Meeting of the Council at Brisbane in May.

Constitution

The Executive Committee has appointed a sub-committee consisting of the Chairman, Professor Greenwood, Sir Macfarlane Burnet and Sir David Rivett to report to it on the constitution of the A.N.R.C.

News

E. D. Adrian: President of the Royal Society

At the 288th Anniversary Meeting, Professor E. D. Adrian, O.M., was elected President of the Royal Society. Professor Adrian has held the Foulerton Research Professorship of the Royal Society and is Professor of Physiology in the University of Cambridge, where, except for his hospital work as a student and service in World War I, he has worked since his student days. A pupil of the late Dr. Keith Lucas, he has continued and amplified the work of that pioneer in the field of neurophysiology, and was awarded the Nobel Prize in Medicine in 1932. He has held the office of Foreign Secretary to the Royal Society since 1946, and has also served as a member of Council for three years. He has been an outstanding member of the Physiological Society for many years, and was Editor of the *Journal of Physiology* for ten years. Among his many distinctions may be mentioned the Royal Medal in 1934, the Copley Medal in 1946, the Croonian Lectureship in 1931, the Ferrier Lectureship in 1938, the Baly Medal of the Royal College of Physicians in 1929, and the Order of Merit in 1942.

The new President's long series of published papers deal mostly with the properties of nerve fibres, and with investigations on the central nervous system. Most of the fundamental work in these fields today rests on the foundations of precise knowledge which he laid. The whole subject of electroencephalography, for example, rests almost entirely on his fundamental investigations; he was largely responsible for the development of techniques by which the passage of the sensory impulses may be traced from the sensory nerve endings along their path to their final destination at the cerebral cortex.

Royal Society Fellowships, 1951

- C. S. Beals (astronomy, Canada): Observational astrophysics; Broadened emission lines of stars; Interstellar lines.
- J. S. K. Boyd (Wellcome Laboratories of Tropical Medicine, London): Bacteriology and immunology; Dysentery bacilli, typhus fevers, tetanus.

D. G. Catchside (plant cytogenetics, Cambridge): Cytology and inheritance of plants and animals.

A. H. Cook (Brewing Industry Research Foundation, London): Organic chemistry; Fungal antibiotics; Synthesis of heterocyclic compounds.

S. J. Folley (National Institute for Research in Dairying): Physiology and biochemistry of lactation; Influence of hormones on milk secretion.

H. Frohlich (theoretical physics, Liverpool): Application of quantum theory to physics of solid state; Properties of insulators; Superconductivity; Theory of atomic nuclei.

G. Gee (Rubber Producers Research Association): Properties of substances of very high molecular weight.

H. A. Heilbronn (mathematics, Bristol): Analytic theory of numbers; Class-number of quadratic fields.

G. Herzberg (physics, Canadian National Research Council): Molecular and atomic spectra.

J. B. Hutchinson (Central Cotton Research Station, Uganda): Genetical studies of the cotton plant; Classification of the genus and evolution of its species.

H. R. Ing (pharmacological chemistry, Oxford): Chemistry of drugs; Chemical aspects of drug action.

D. Lack (Edward Grey Institute of Field Ornithology, Oxford): Behaviour and evolution of birds; Formation of species and races of the finches of the Galapagos Islands.

T. R. R. Mann (biochemist, Agricultural Research Council): Carbohydrate and phosphorus metabolism of muscle, moulds, and mammalian seminal fluid; Metalloprotein enzymes.

K. A. G. Mendelssohn (experimental physics, Oxford): Properties of liquid helium; The superconducting state.

A. Neuberger (National Institute of Medical Research, London): Biochemistry of amino-acids and proteins.

L. B. Pfeil (Mond Nickel Co. Ltd.): Metallurgical research on ferrous and non-ferrous metals.

J. A. Prescott (Waite Agricultural Research Station, Adelaide): Soil types of Australia, their geographical distribution and relation to climate and vegetation.

M. H. L. Pryce (physics, Oxford): Quantum mechanics and quantum electrodynamics; Properties of the solid state at low temperatures.

W. J. Pugh (Geological Survey and Museum, London): Ordovician and Silurian rocks of Wales.

J. A. Ratcliffe (physics, Cambridge): Development of the scientific basis for radio communication.

T. A. Stephenson (zoology, Aberystwyth): Marine biology; Growth and Reproduction of corals; Distribution of animals and plants on the sea shore.

W. H. Thorpe (entomology, Cambridge): Insect physiology and animal behaviour.

P. J. du Toit (C.S.I.R., South Africa; formerly South African Veterinary Research Institute): Diseases of domestic cattle; Diseases due to soil deficiencies and infections transmitted by ticks.

A. M. Turing (Computing Machine Laboratory, Manchester): Mathematical logic; Computable numbers.

A. R. J. P. Ubbelohde (physical chemistry, Belfast): Structural and thermodynamic questions; Reaction mechanism.

Royal Society Lectures, 1951

The Royal Society has announced the following lectures for 1951. The Croonian Lecture, 7 June, by Professor R. A. Peters, M.C., M.D., F.R.S., Whitley Professor of Biochemistry in the University of Oxford, on 'Lethal Synthesis'. The Bakerian Lecture, 21 June, by Professor E. K. Rideal, M.B.E., F.R.S., Professor of Chemistry in King's College, University of London, on 'Reactions in Monolayers'. The Leeuwenhoek Lecture, 13 December, by Dr. C. H. Andrewes, F.R.S., of the National Institute for Medical Research, on 'The Place of Viruses in Nature'.

Awards of the Royal Australian Chemical Institute

Dr. G. M. Badger, senior lecturer in Chemistry at the University of Adelaide, and Professor N. S. Bayliss, Professor of Chemistry at the University of Western Australia, have been awarded the *H. G. Smith Memorial Medals* for 1950. The awards are for the best contributions to the development of chemical science in Australia, in the organic and biochemistry fields, and in the general and physical chemistry fields, respectively. Both recipients are graduates of the University of Melbourne.

John Robert Hall has been awarded the *Masson Memorial Scholarship* for 1951. Mr. Hall graduated as a B.Sc. in the University of Western Australia. While Masson Scholar he will complete the post-graduate year for a B.Sc. (Honours) degree. This is the eleventh award of the Scholarship and the second time it has gone to Western Australia.

International Scientific Film Congress

The Sydney Scientific Film Society has received a notice from the organizing committee of the V Annual Congress of the International Scientific Film Association, stating that this will take place at The Hague, Holland, on 15-21 September 1951. In addition to the usual business meetings there will be special meetings of

Australian Science Abstracts

SUPPLEMENT TO THE AUSTRALIAN JOURNAL OF SCIENCE,

June, 1951.

EDITOR: STEPHEN J. COPLAND, c.o. Linnean Society of N.S.W., Science House, Gloucester Street, Sydney.

Vol. 28 **No. 7**

PALÆONTOLOGY.

Hon. Abstractor: H. O. Fletcher.

15762. **Selling, Olof H.** Some Tertiary Plants from Australia, Preliminary Report. *Svensk Botanisk Tidskrift*, xliv (4), 1950 (Uppsala), 551–561.—A preliminary account of three new species of *Araucaria* and one of *Podocarpus* (section Polypodiopsis) from the Tertiary of Australia. All of them have their closest recent counterparts in New Caledonia, New Mecklenburg and Fiji. Similar instances are mentioned of rain forest elements that once extended south to Tasmania but have since retreated north and partly disappeared from the Australian continent. Many more will be given in a later publication at present comprising novelties in some 50 families. In this connection the genera *Celyphina*, *Penteune* and *Rhytidotheca* are rejected, also *Pseudopinus*, which was once compared with Boreal genera. The descriptions and new combinations have been brought together into the Appendix.

15763. **Teichert, Curt.** Climates of Australia during the Carboniferous, Permian and Triassic. *Int. Geol. Congress "Report of the Eighteenth Session"*, Great Britain, 1948, pt. 1, 206–208.

15764. **Hill, Dorothy.** Middle Devonian Corals from the Buchan District, Victoria. *Proc. Roy. Soc. Vict.*, (n.s.), lxii, 1950, 2, 137–164.—The fossil corals of the Buchan district, Victoria, are described and figured, including five new species of Rugosa and six of Tabulata, and the age of the Buchan Series deduced to be Couvinian. The occurrence of squamulæ in the Favositidæ is discussed, and the types found in the Buchan favositids described, with notes on the wall structure in *Favosites*.

ZOOLOGY.

Hon. Abstractor: A. Musgrave.

15765. **Allan, Joyce.** Land Shells of Australia. Part II. *Aust. Mus. Mag.*, x (3), Sept. 15, 1950, 80–83, illustr.

15766. **Allan, Joyce.** Australian Shells. With related animals living in the sea, in freshwater and on the land. 8vo. Georgian House, Melbourne, 1950, pp. xix, 470, 12 colour pls., 32 half-tone pls., 112 tfs.—A popular book treating with the mollusca of Australia, their structure, ecology, habits, distribution, uses, collection, and classification. Popular and scientific names are given, but the author has omitted the author's names and dates of publication. The plates are unnumbered, but are referred to in the text. The illustrations are by the author and 1240 species are herein depicted. A glossary and index completes the work.

15767. **Amadon, D.** Australian Mud Nest Builders. *Emu*, 1 (2), Oct., 1950, 123–127.—Deals with the White-winged Chough, *Corcorax melanorhamphos*, the Grey Jumper or Apostle Bird, *Struthidea cinerea*, the Magpie-lark, *Grallina cyanoleuca*, and suggests that "the family Grallinidæ be tentatively defined to include *Grallina*, *Pomareopsis* (if recognized), *Corcorax* and *Struthidea*. If later evidence from studies of comparative anatomy or behaviour shows that it is not correct to associate *Grallina* with the other two genera, it will be necessary to recognize two families."

15768. **Blackburn, M.** The Tasmanian Whitebait, *Lovettia seali* (Johnston), and the Whitebait Fishery. *Aust. J. Mar. Freshwater Res.*, i (2), Dec., 1950, 155–198, pls. 1–6, 5 tfs.—The author deals with the biology of the aplochitonid *Lovettia seali* (Johnston), which comprises over 95 per cent. of the Tasmanian whitebait catch. Over 78,000 fish from 95 samples were sexed and measured, and 1200 were classified as to maturity, pigmentation stages, and the presence or absence of food in the stomach. Vertebra counts were made for 1200 specimens, and there were other observations upon smaller amounts of material.

15769. **Blackburn, M.** Studies on the Age, Growth, and Life History of the Pilchard, *Sardinops neopilchardus* (Steindachner), in Southern and Western Australia. *Austr. J. Mar. Freshwater Res.*, i (2), Dec., 1950, 221–258, pls. 1–5, tfs. 1–4.—The author completes the preliminary study of the biology of the unexploited Australian pilchard from material collected over almost the whole of its subcontinental range, viz. Victorian, Tasmanian, South Australian and Western Australian waters. The possible influences of distribution, size and condition of fish on future economic exploitation are discussed.

15770. **Boardman, W.** The Hair Tracts in Marsupials. Part V. A Contribution on Causation. *Proc. Linn. Soc. N.S.W.*, lxxv (5–6), Dec. 21, 1950, 254–266.

15771. **Boardman, W.** The Hair Tracts in Marsupials. Part VI. Evolution and Genetics of Tract Pattern. *Proc. Linn. Soc. N.S.W.*, lxxv (5–6), Dec. 21, 1950, 267–272.

15772. **Boardman, W.** The Hair Tracts in Marsupials. Part VII. A System of Nomenclature. *Proc. Linn. Soc. N.S.W.*, lxxv (5–6), Dec. 21, 1950, 273–278, 2 tfs.

15773. **Brown, A. G.** The Birds of " Turkeith ", Victoria. Notes from the Diary of the late Urquhart Ramsay. *Emu*, l (2), Oct., 1950, 105–113.—Lists birds from a sheep station lying north of Mt. Gellibrand, between Winchelsea and Colac in the western district of Victoria.

15774. **Burfield, S. T.** Chætognatha. *B.M. (N.H.) Gr. Barrier Reef Exped. Sci. Rpts.*, v (8), Jan. 28, 1950, 459–473, tfs. 1–6.

15775. **Carlgren, O.** Actiniaria and Corallimorpharia. *B.M. (N.H.) Gr. Barrier Reef Exped. Sci. Rpts.*, v (7), March 10, 1950, 427–457, tfs. 1–28.

15776. **Chisholm, A. H.** Birds Introduced into Australia. *Emu*, l (2), Oct., 1950, 97–100.

15777. **Cleland, K. W.** Respiration and Cell Division of Developing Oyster Eggs. *Proc. Linn. Soc. N.S.W.*, lxxv (5–6), Dec. 21, 1950, 282–295.

15778. **Cleland, K. W.** The Intermediary Metabolism of Unfertilized Oyster Eggs. *Proc. Linn. Soc. N.S.W.*, lxxv (5–6), Dec. 21, 1950, 296–319, tfs. 1–3.

15779. **Condon, H. T.** Variation in the Brown Hawk. *Emu*, l (3), Jan., 1951, 152–174, pls. 15–18.—*Falco berigora* and its subspecies are here dealt with ; these are *F. berigora berigora* V. and H. ; *F. berigora tasmanica* (Mathews) ; *F. berigora centralia* (Mathews) ; *F. berigora melvillensis* (Mathews) ; *F. berigora occidentalis* (Gould).

15780. **Coppleson, V. M.** A Review of Shark Attacks in Australian Waters since 1919. *Med. J. Austr.*, ii, 37th year, No. 19, Nov. 4, 1950, 680–687, tfs. i–vii.—Figures the commonly suspected man-eating sharks and the teeth of these species.

15781. **Crowcroft, P.** A Revised Description of *Dolichopera macalpini* Nicoll, 1914 (Plagiorchiidæ-Trematoda). *Pap. Proc. R. Soc. Tasm.*, 1949 (Sept. 15, 1950), 73–76, pl. 1.

15782. **Fraser-Brunner, A.** Note on the Fishes of the Genus *Antigonia* (Caproidæ). *Ann. Mag. Nat. Hist.*, (12) iii (32), Aug., 1950, 721–724.

15783. **Glauert, L.** A Handbook of the Snakes of Western Australia. 8vo. Perth. (Published by the Western Australian Naturalists' Club, Perth), 1950, pp. 50, tfs. 1–15, col. frontispiece.—By means of keys, descriptions and figures, the author has shown how to separate the various groups by easily recognized characters and how to identify the poisonous species from one another.

15784. **Godsil, H. C., and Holmberg, E. K.** A Comparison of the Bluefin Tunas, Genus *Thunnus* from New England, Australia and California. *California Bur. Mar. Fisher. Bull.* lxxvii, 1950, 1–55, tfs. 1–15.—The Australian tuna, *Thunnus maccoyii*, externally and anatomically quite distinct from Atlantic and Pacific *T. thynnus*, as shown by direct comparison and detailed dissections.

15785. **Guiler, E. R.** A Preliminary Description of *Fabia hickmani* sp. nov. (Pinnotheridæ). *Pap. Proc. R. Soc. Tasm.*, 1949 (Sept. 15, 1950), 67–72, tfs. 1–4.—Describes a new species of pea crab found inhabiting the mussel, *Mytilus planulatus* Lam. The male crab and the five stages of the female crab are described. The number of mussels infested by this crab is very high, reaching 100 per cent. in some places. The mussel beds were in the estuary of the Derwent and other southern Tasmanian places.

15786. **Guiler, E. R.** The Intertidal Ecology of Tasmania. *Pap. Proc. R. Soc. Tasm.*, 1949 (Sept. 15, 1950), 135–201, pls. i–ii, tfs. 1–32.—The author reviews the general status of marine ecology in Australia and the literature. The physical environment in south Tasmania is described in detail, the tides receiving particular attention. As a result of this treatment it is shown that July, December and January are critical months for shore animals. This is verified by some experiments carried out on the colonization of bare rocks. The zonation is examined in the Blackman's Bay area and compared as far as possible with that in other parts of Australia.

15787. **Guiler, E. R.** Notes on Tasmanian Marine Sponges. *Rec. Queen Vict. Mus. Launceston*, iii (2), Oct. 2, 1950, 5–14.

15788. **Hindwood, K. A.** The Upland Plover, or Bartram's Sand-piper, in Australia. *Emu*, l (2), Oct., 1950, 91–96, pl. 11.—*Bartramia longicauda*.

15789. **Hindwood, K. A.** Bird/Insect Relationships, with Particular Reference to a Beetle (*Platydema pascoei*) Inhabiting the Nests of Finches. *Emu*, l (3), Jan., 1951, 179–183, fig.

15790. **Hindwood, K. A.** The White-throated Honeyeater. *Emu*, l (3), Jan., 1951, 183–188, figs., map.—*Melithreptus albogularis* Gould.

15791. **Hiscock, I. D.** Shell Movements of the Freshwater Mussel, *Hyridella australis* Lam. (Lamellibranchiata). *Aust. J. Mar. Freshw. Res.*, i (2), Dec., 1950, 259–268, tfs. 1–4.—This paper represents an attempt by the author to learn something of the feeding habits of a mussel widely distributed in Australian rivers, and to determine the effect of various conditions of light and temperature on its shell movements.

15792. **Hitchcock, W. B.** Notes on the Grey-mantled Albatross. *Emu*, l (2), Oct., 1950, 135–137.—*Phoebetria palpebrata*—recorded from specimen picked up on beach of Discovery Bay, Nelson, Victoria.

15793. **Hodgson, M. M.** A Revision of the Tasmanian Hydroida. *Pap. Proc. R. Soc. Tasm.*, 1949 (Sept. 15, 1950), 1–65, 92 tfs.—Gives an account of 64 species of Calyptoblastic Hydroids occurring in Tasmanian waters. This number includes 16 forms not previously recorded from this region. Of these one is a new species: *Halecium fragile*.

15794. **Johnson, R. A., and Moore, D. D.** A Particularly Dangerous Marine Borer—*Nausitora messeli*. *Port of Sydney*, iii (1), July, 1950, 18–22, illustr.

15795. **Johnston, T. H., and Angel, L. Madeline.** Larval Trematodes from Australian Freshwater Molluscs. Part XIII. *Trans. R. Soc. S. Austr.*, lxxiii (1), Dec. 16, 1949, 22–28, tf. 1.—*Cercaria beckwithæ* n. sp. from *Planorbis isingi*, at Tailem Bend, S.A., it is considered to be the larval form of a frog lung fluke, *Hæmatoloechus*. *C. tetradenoidea* nom. nov. for *C. tetradena* Johnston and Beckwith, 1945, *nec* Miller, 1935.

15796. **Johnston, T. H., and Mawson, Patricia M.** Some Nematodes from Australian Hosts, together with a Note on *Rhabditis allgeni*. *Trans. R. Soc. S. Austr.*, lxxiii (1), Dec. 16, 1950, 63–71, tfs. 1–19.—Known species of nematodes are recorded from additional hosts and localities. *Austrostrongylus potoroo* from a marsupial *Potorous tridactylus*, from King Island, Bass Strait; and *Contracæcum podicipitis* from the crested grebe, *Podiceps cristatus*, from South Australia, are described as new. *Zoniolaimus setifer* (Johnston and Mawson, 1940) *nec*. Cobb, 1898, is renamed *Z. chætophorus*. *Tetrameres fissispina* (Dies.) is described from an Australian duck, *Anas superciliosa*. The free-living nematode species, *Rhabditis campbelli* Allgen, from Campbell Island, is a synonym of *R. allgeni* Johnston.

15797. **Johnston, T. H., and Muirhead, Nancy G.** Larval Trematodes from Australian Freshwater Molluscs. Part XIV. *Trans. R. Soc. S. Austr.*, lxxiii (1), Dec. 16, 1949, 102–108, tfs. 1–12.—A new 35-spined echinostome cercaria, *C. natans*, is described from *Planorbis isingi* from the lower Murray. The metacercaria has been obtained experimentally from the gastropods, *Planorbis isingi* and *Amerianna* sp., and from the tadpole of *Limnodynastes tasmaniensis*. A closely allied 37-spined cercaria is reported from *Amerianna pyrimidata* and *Planorbis isingi*, its metacercaria having been obtained experimentally from these two species of snails as well as from the tadpole just named. *Cercaria lethargica* n. sp. is described from the gastropod, *Plotiopsis tatei*, the metacercaria occurring (experimentally) in a fish, *Gambusia*. The adult is perhaps a Psilostome or a Fellodistome.

15798. **Kinghorn, J. R.** The Taipan. *Austr. Mus. Mag.*, x (3), Sept., 1950, 73–75, illustr.—*Oxyuranus scutellatus*.

15799. **Lamm, D. W., and Calaby, J. H.** Seasonal Variation of Bird Populations along the Murrumbidgee in the Australian Capital Territory. *Emu*, l (2), Oct., 1950, 114–122.

15800. **Landolt, H. H.** Ueber den zahnwechsel bei Selachiern. *Rev. Suisse Zool. Geneve*, liv, 1947, 305–367, 35 tfs. (*Fide Zool. Rec.*, 1947 (1950), 17 and 45.)—Figures tooth replacement in Port Jackson Shark.

15801. **Lendon, A.** Australian Parrots in Captivity. *Avicult. Mag.*, lvi (4), July-Aug., 1950, 161–167; *loc. cit.*, (5), Sept.-Oct., 1950, 218–226.

15802. **Littlejohns, R. T.** Further Notes on the Mistletoe Bird and the Mistletoe Parasite. *Emu*, l (2), Oct., 1950, 84–90.

15803. **Lord, E. A. R.** Notes on the Blue-faced Honeyeater. *Emu*, l (2), Oct. 1950, 100–101.—*Entomyzon cyanotis*.

15804. **McGill, A. R.** An Australian Review of the Sanderling. *Emu*, l (3), Jan., 1951, 197–206, map.—*Crocethia alba*.

15805. **Massey, V., and Rogers, W. P.** The Intermediary Metabolism of Nematode Parasites. I. The General Reactions of the Tricarboxylic Acid Cycle. *Austr. J. Sci. Res.*, (B) iii (2), May, 1950, 251–264.

15806. **Ormsby, A. I.** The Marsh Snake (*Denisonia signata*). *Proc. R. Zool. Soc. N.S.W.*, 1948–49 (May, 1950), 29–31.

15807. **Pearson, J.** A Further Note on the Female Urogenital System of *Hypsiprymnodon moschatus* (Marsupialia). *Pap. Proc. R. Soc. Tasm.*, 1949 (Sept. 15, 1950), 203–209, tfs. 1–4.

15808. **Pearson, J.** The Relationships of the Potoroidæ to the Macropodidæ (Marsupialia). *Pap. Proc. R. Soc. Tasm.*, 1949 (Sept. 15, 1950), 211–229, 21 tfs.

15809. **Pope, Elizabeth.** Earthworms and Soil-building in Australia. *Austr. Mus. Mag.*, x (3), Sept. 15 (=29), 1950, 89–94, illustr.

15810. **Prudhoe, S.** On the Taxonomy of Two Species of Pelagic Polyclad Turbellarians. *Ann. Mag. Nat. Hist.*, (12) iii (32), Aug., 1950, 710–716, tf. 1.

15811. **Serventy, V. N.** Fairy Terns on Rottnest Island. *W. Austr. Nat.*, Perth, ii (6), Sept. 18, 1950, 126–128.—*Sterna nereis*.

15812. **Serventy, V. N., and White, S. R.** The Roseate Tern: Notes on the Nesting Behaviour. *Emu*, l (3), Jan., 1951, 145–151, pls. 12–14, maps, graph.—*Sterna dougallii*—on Pelsart Island, in the Abrolhos Group, W.A.

15813. **Sheard, K.** Plankton Characteristics at the Cronulla Onshore Station, New South Wales, 1943–46. *Bull. Commonw. Sci. Ind. Res. Organ.*, Melbourne, No. 246, 1949, 1–23, 5 tfs.—An examination of the general plankton characteristics, water temperature records, and pelagic fish occurrences at the Cronulla onshore station, N. S. Wales, 1943–1946, disclosed similar general annual trends with considerable variation in the detail of the pattern in each year. Monthly records of certain species of the zooplankton indicate that the important food chain organism, *Nyctiphanes australis*, breeds in the area, and that *Nematoscelis difficilis*, *Thysanoessa gregaria* and *Evadne nordmanni* are possible indicators of slope water; *Euphausia recurva* and *Cavolinia uncinata* of ocean water. Of these the last is a Pteropod, the remainder Crustacea.

15814. **Simpson, D. A.** The Epiphyseal Complex in *Trachysaurus rugosus*. *Trans. R. Soc. S. Aust.*, lxxiii (1), Dec. 16, 1949, 1–5, pl. i, figs. 2–4; tfs. 1, 5, 6.

15815. **Sperber, Christina.** A Taxonomical Study of the Naididæ. *Zool. Bidrag.*, Uppsala, xxviii, 1948, 1–296, pls. 1–21, tfs. 1–29.—In the paper the author deals with the anatomy, systematics, phylogenetic relationships of the genera and of the relations to some other Oligochæte families, and gives an account of the techniques employed.

15816. **Stokell, G.** A Revision of the Genus *Paragalaxias*. *Rec. Queen Vict. Mus. Launceston*, iii (i), July 31, 1950, 1–4, pl. 1.

15817. **Strand, E.** Miscellanea nomenclatorica zoologica et palæontologica. *Folia zool. hydrobiol. Riga*, xii, 1943, 94–114.—Fishes: *Strandichthys*.

15818. **Teague, P. W.** Gouldian Finches (*Poephila gouldiæ*). *Avicult. Mag.*, lvi (5), Sept.-Oct., 1950, 191–196, col. pl.

15819. **Thomson, J. M.** The Effect of a Period of Increased Legal Minimum Length of Sea Mullet in Western Australia. *Austr. J. Mar. Freshw. Res.*, i (2), Dec., 1950, 199–220, 11 figs.

15820. **Troughton, E.** Bandicoots—Rare and Otherwise. *Aust. Mus. Mag.*, x (3), Sept. 15 (= 29), 1950, 95–98, illustr.—The Southern Short-nosed Bandicoot, *Isoodon obesulus*; the Long-nosed Bandicoot, *Perameles nasuta*.

15821. **Troughton, E.** Bandicoots—Rare and Otherwise. Part II. *Aust. Mus. Mag.*, x (4), Dec. 15 (= 20), 1950, 113–117, illustr.—Deals with the Barred-back Bandicoots: *Perameles gunni* from Tasmania; *P. fasciata* from inland Victoria and western N. S. Wales; the Pig-footed Bandicoot, *Chæropus ecaudatus*; and the Bilbies or Rabbit-bandicoots, *Macrotis lagotis* and *M, leucura*, from inland Australia.

15822. **Wheeler, R.** Further Observations from Fisherman's Bend, Melbourne. *Emu*, l (2), Oct., 1950, 73–83, pl. 10.—Additional notes on birds observed in the area, of which ninety-seven have now been listed; twenty-two breeding there.

15823. **White, S. R.** Plumage Changes in the Red-shouldered Wrens (*Malurus*). *W. Aust. Nat.*, Perth, ii (6), Sept. 18, 1950, 121–125, tfs. 1–2.

15824. **Whitley, G. P.** The Opah or Moonfish in Australasia. *Aust. Mus. Mag.*, x (3), Sept. 15 (= 29), 1950, 76–78, illustr. and frontispiece.—*Lampris regius*.

15825. **Whitley, G. P.** Clingfishes. *Aust. Mus. Mag.*, x (4), Dec. 15 (= 20), 1950, 124–128, illustr.—General account of the family Gobiesocidæ.

15826. **Whitley, G. P.** A Large Stargazer. *Aust. Mus. Mag.*, x (4), Dec. 15 (= 20), 1950, 135, illustr.—*Ichthyscopus sannio*—mottled stargazer, other forms cited.

GEOLOGY.

Hon. Abstractor: R. O. Chalmers.

15827. **Baker, G.** Geology and Physiography of the Moonlight Head District, Victoria. *Proc. Roy. Soc. Vict.*, lx, 1948 (issued 1950), 17–43.—The lithology, distribution and stratigraphical relationships of Jurassic, Eocene, Pleistocene and Recent deposits are discussed and a vertical stratigraphical column based on coastal sections has been prepared to indicate approximate thickness of post-Jurassic sediments.

15828. **Baker, G.** Petrology of No. 3 Tunnel, Kiewa Hydro-electric Scheme, Bogong, Victoria. *Proc. Roy. Soc. Vict.*, lx, 1948 (issued 1950), 173–188.—The rocks consist of mesocratic granodiorite intruded into pre-existing regional metamorphic rocks (? Ordovician) and injected by a group of leucocratic and melanocratic dyke rocks.

15829. **Beck, C. W.** Differential Thermal Analysis Curves of Carbonate Minerals. *Am. Min.*, xxxv, 11 and 12, 1950, 985–1013.—Fifty-one curves are presented and interpreted, amongst them one for dundasite, from Dundas, Tasmania.

15830. **Brown, H., and Goldberg, E. D.** The Neutron Pile as a Tool in Quantitative Analysis; the Gallium and Palladium Content of Iron Meteorites. *Science*, cix, 8/3/49, 347–353.—Determinations of these two elements were done on several iron meteorites.

15831. **Brown, H., and Goldberg, E. D.** A New Determination of the Relative Abundance of Rhenium in Nature. *Phys. Rev.*, lxxvi, 8, 1949, 1260–1261.—Determinations were done on five iron meteorites and the Henbury from Central Australia is found to contain 1·4 parts per million.

15832. **Carroll, Dorothy, Brewer, R., and Harley, Joyce E.** Pebbles from the Upper Hunter River Valley, N.S.W. *Proc. Roy. Soc. N.S.W.*, lxxxiii, 4, 251–262.—The pebbles collected came from various Triassic and Permian beds and from gravels of certain river terrace soils. This has resulted in more precise descriptions of the various beds.

15833. **Chace, F. M.** Origin of Bendigo Saddle Reefs with Comments on Form of Ribbon Quartz. *Ec. Geol.*, xliv, 7, 1949, 561–597.

15834. **Chamberlain, N. G.** Preliminary Report on the Geophysical Survey of the Collie Coal Basin. *Bur. Min. Res., Geol. and Geophysics* Rept. No. 1 (Geophysical Rept. No. 1), date of publication not given, pp. 5.—It has been possible by means of a gravity survey to establish with considerable success the full extent of the basin so that it is possible now to define those areas where drilling may be carried out with a reasonable expectation of proving additional reserves of coal.

15835. **Cochrane, G. W., and Samson, H. R.** The Geology of the Nowa Nowa-South Buchan Area, Victoria. *Proc. Roy. Soc. Vict.*, lx, 1948 (issued 1950), 93–122.—Porphyroids developed by shearing at the junction of Lower Devonian volcanics and Upper Ordovician basement rocks have been mapped in detail. Tuffaceous sandstones, some fossiliferous, interbedded with the volcanics, and a small granitoid complex, are described.

the permanent committees of the Association covering the fields of research films, medical films and industrial films. As is customary, the Congress will conclude with an elaborate Festival of Scientific Films. An invitation has been sent to all members of the Association, Australia being amongst them, to submit scientific papers and research films for the permanent committees, and scientific films for the Festival. The only Australian film shown last year at Florence was the C.S.I.R.O. documentary, 'Radiophysics, 1949'. It is hoped that this year a more representative selection of Australian scientific films can be sent.

All enquiries should be sent to the Secretary, Sydney Scientific Film Society, Science House, 157 Gloucester Street, Sydney.

New Canadian Journals

The National Research Council, Canada, has created six new scientific journals to take over the functions of the *Canadian Journal of Research*, which has ceased to be published under this name as from January 1951. The new journals are, respectively, the *Canadian Journals of Physics, Chemistry, Botany, Zoology, Medical Sciences and Technology*, corresponding to Sections A-F of the former journal.

Sociedad Veterinaria de Zootecnia

The Sociedad Veterinaria de Zootecnia, whose membership comprises over 3500 Spanish veterinarians, is linked with over 200 organizations concerned with animal production in other countries.

Advice has recently been received from the Secretary-General (Professor Carlos Luis de Cuenca, Faculty of Veterinary Science, Apartado 1200, Madrid) that the Society's Eleventh Congress will be held in October 1951. A cordial invitation is extended to representatives from other countries, whose organizations are asked to communicate with Professor Luis de Cuenca in order that official information regarding the Congress may be forwarded.

C.S.I.R.O. Erosion Survey

A detailed study of erosion has been made by C.S.I.R.O. in 650 square miles of land adjacent to Dookie, Victoria. The area surveyed is typical of the better cereal-growing districts in north-eastern Victoria which are subject to a serious water erosion hazard. The report on the survey is mainly a technical description of the soils, geology, vegetation and climate of the area; but a discussion in practical terms is included of its agriculture, present land-use and management practices for soil conservation.

Interesting relationships are shown between such climatic factors as the intensity of rainfall and the times of the year at which storm rains occur and consequent soil losses and erosion damage. It is not only the total amount of rain, but the time when there is 'influential' rain which is of great importance. (Influential rain is rain such that the ratio of precipitation to evaporation during a month is greater than 0:3.) The climatic records show that in the north-east there is usually a period of six months' influential rain beginning most frequently in May and ending in October, the amount of influential rain being between 10 and 20 inches. This constitutes the growing season, of which June and July are usually too cold for much plant growth, so that the success of the season depends largely on the spring rains of late August, September and October. In the rare years when the season finishes early the crop yields are low and pasture growth is poor. This makes pasture management difficult, since in such years farmers find themselves overstocked and the country left bare in the following summer. Such conditions, in conjunction with the higher-intensity rains of the summer and autumn (which incidentally appear to occur more frequently after such a dry season), are the main cause of erosion in the area. (C.S.I.R.O. *Bulletin*, No. 243.)

Nutritional Research in New Hebrides

Miss Sheila Malcolm, an Australian nutritionist who for the past year has been carrying out investigations for the South Pacific Commission in Rabaul, New Ireland and the Trobriands, will spend the next twelve months in the New Hebrides on further research amongst the native inhabitants.

While Miss Malcolm's investigations concerning nutrition have included adult populations, her main study has been of infant diet, particularly in relation to the preparation from local resources of the most suitable foods for infants during weaning. She will continue this work in the New Hebrides in three different areas where the inhabitants have differing degrees of contact with the European way of life. The first will be in a village near Port Vila, where the natives have very close contact with Europeans. The second includes the villages of the Tanna Islands, where the natives have regular incomes from the sale of produce and can thus purchase European foods to supplement their own. The third is to be in the villages of the Maskelynes Islands, where the natives are nearest to the ancestral way of life and live entirely on their own traditional foods.

Jubilee Conversazione, Sydney

A large gathering of members and friends, as well as guests representative of many sections of the community, was present at the Conversazione held in the Great Hall of the University of Sydney on 18 April 1951. Organized by the Royal Society of New South Wales, a display of exhibits was arranged to illustrate developments in pure and applied science during the past fifty years. The following societies took part: The Royal Society of New South Wales; The Institution of Engineers,

Australia, Sydney Division; The Royal Australian Chemical Institute, N.S.W. Branch; The Australasian Institute of Mining and Metallurgy; The Institute of Physics, New South Wales; The Linnean Society of New South Wales.

The opening address was delivered by Sir David Rivett who, in the course of his remarks, stated that the exhibition was an example of scientific achievement presented in the free and open manner characteristic of the search for knowledge at its best. In proposing and supporting a vote of thanks to Sir David Rivett, Mr. V. J. F. Brain and Professor N. F. Astbury mentioned that no more appropriate person could have been chosen to address the gathering, since Sir David had been associated with probably the most important developments in science that had taken place in Australia.

Exhibits included the following: A display illustrating the art and science of recording and reproduction of sound over the past fifty years; lighthouse lamps—old and new; rain-making exhibit, showing the formation of ice crystals in supersaturated air by addition of 'dry-ice'; old and modern equipment for flashlight photography; display of X-ray tubes showing development from the primitive type to a modern rotating anode tube; display illustrating results of chemical research applied to national problems of food, health, clothing, transport; stages in the manufacture of cemented tungsten carbide, used for cutting tools; Australian essential oils, illustrating results of pure and applied research during the past fifty years. Also included in the exhibition were original drawings and paintings of natural history subjects by Dr. Stuart of the First Fleet, and the pocket compass of Charles Darwin.

In view of the work entailed in setting up the exhibits, the organizing committee decided to throw open the exhibition to the general public on the following day, 19 April 1951.

Niue Island Soil Survey

A soils survey of Niue Island has been made by the New Zealand Soil Bureau. In this isolated community the local production of foodstuffs is most important, and the limited soil resources must be husbanded with care. These soils are formed from volcanic ash, which lies on a rugged surface of coral limestone. Of a total area of 64,900 acres, only about one-half has a soil covering available for agriculture, the remainder consisting of bare limestone rock with the ash soil occurring in narrow fissures. This rocky land grows forest and coastal scrub. The deeper soils occur as pockets throughout the island and total approximately 32,000 acres. Some 24,000 acres are used for food production on a five-year to nine-year rotation, with a spell of three to five years in which the soil is allowed to revert to a native shrubland cover. These soils are maintaining their fertility and producing good crops, although the interval between cropping tends to be shorter near villages and the soil fertility falls correspondingly. On some 8250 acres, soils formerly used for agriculture have now reverted to fern and scrub, since these soils no longer have the natural fertility to grow food crops. A solution of this problem is necessary for the future well-being of the islanders.

Research on Veneer Timbers

Heavy inroads into hoop pine forests during and after the War have depleted the supplies of suitable logs of this timber, which was formerly the chief veneer and plywood timber in Australia. Substitute timbers must therefore be found. Researches by the Division of Forest Products of C.S.I.R.O. on more than sixty species indigenous to or extensively planted in Australia, are described in its Bulletin No. 260, recently published.

The report provides, for each timber, information on the need for steam treatment or heating in water, to soften the logs before veneer cutting; the thickness of veneer which may be cut; recommended drying conditions; the proportion of usable dry veneer which may be recovered; and the quality characteristics and potential uses of the resulting veneer. Mention is also made of the treatment of veneers necessary to prevent staining by moulds and other fungi and to immunize sapwood against Lyctus borer attack. Copies of the Bulletin are available on request.

University of Tasmania

Dr. H. Lowig, lecturer in Mathematics, and formerly of the University of Prague, has been approved for admission to the degree of Doctor of Science, in respect of published papers on Hilbert space and its generalization and on the theory of lattices.

University of Western Australia

The Chair of Mathematics, rendered vacant by the retirement of Professor Weatherburn, has been filled by the appointment of A. L. Blakers, a graduate of Western Australia. Professor Blakers won a Hackett studentship in 1939 and later held teaching positions at Princeton, at Michigan State University and at the University of Lehigh. He served during the War with the Royal Canadian Air Force.

University of Melbourne

The young Melbourne physicist, John Jelbart, was killed in an accident at Norsel Bay, in the Antarctic, on 21 February. The late John Jelbart, who was 24, graduated Bachelor of Science in 1947 and had been a member of the original party which established the Heard Island base in that year. He had been appointed to accompany the present joint Norwegian-British-Swedish expedition as an Australian observer.

Dr. F. J. R. Hird returned from Cambridge at the end of February to take up the newly-created senior lectureship in Agricultural Biochemistry. The first recipient of the Sir John and Lady Higgins Scholarship—which he held for four years—Dr. Hird carried out researches at Cambridge on the mechanisms underlying the synthesis of proteins in biological systems.

J. W. Legge, who commenced duty in January as senior lecturer in the Department of Biochemistry, has had considerable research experience, mainly with blood pigments and in enzymology, and during the war worked with the Chemical Warfare Unit of the Australian Army. From 1946 to 1948 he was in Europe as Wellcome Foundation Fellow, chiefly at the University of Cambridge, and on his return to Australia was appointed to a Senior Fellowship with the Australian National Health and Medical Research Council. Among his publications is a standard work on *Hematin Compounds and Bile Pigments*, written jointly with Dr. Lemberg of Sydney.

The Sweet Fellowships

The first awards have been made of the Sweet Fellowships, each valued at £500 a year. The Elizabeth Mary Sweet Fellowship in Medicine has been awarded to Dr. Dora Bialestock, of the University of Melbourne, who will continue her work on serological and biochemical techniques on animal subjects, particularly in relation to nephritis. James Finch, of Wellington, New Zealand, who is a member of the New Zealand Geological Survey, has been granted the George Sweet Fellowship in Economic Geology. His special field is the development and use of optical crystallographic and mineralogical techniques applied to inorganic and organic chemistry. The Georgina Sweet Fellowship in Economic Zoology goes to N. Dobrotvorsky, a Russian-born entomologist who came to Australia as a migrant some twelve months ago. He holds the equivalent of a Master of Science degree of the University of Minsk, and was engaged as demonstrator in Zoology there. In 1931, as assistant at the White Russian Academy of Science, he was found politically 'unreliable' and sent as a senior entomologist to Alma-Ata in far-eastern Russia. He is the author of a number of papers on insect diseases of plants. Each of the Fellows will work at the University of Melbourne under the direction of the head of the department concerned.

University of Queensland

R. H. Greenwood, of the University of Otago, has been appointed senior lecturer in Geography. He is a graduate of Cambridge University with a special knowledge of the geography of the Near East; he served during the war as Admiralty representative to the Egyptian Government Survey at Cairo.

University of Adelaide

P. O. A. L. Davies has been appointed lecturer in Mechanical Engineering. A graduate of the University of Sydney, he was awarded the Institute of Engineers Prize in 1947 and entered Trinity College, Cambridge, in that year. Since September, Mr. Davies has been visiting institutions in Britain and the U.S.A., studying developments in fluid mechanics. He served with the R.A.A.F. from 1941 to 1945.

N.S.W. University of Technology

The Council has announced the following new appointments: Dr. P. R. McMahon, to be Associate Professor of Wool Technology; C. H. Munro, to be Associate Professor of Civil Engineering; J. F. D. Wood, to be Associate Professor of Mechanical Engineering; Dr. A. H. Willis, to be Associate Professor (Research) of Mechanical Engineering; G. Bosson, to be Associate Professor of Mathematics.

University of Sydney

Dr. J. W. Roderick, Assistant Director of Research in the Engineering Department at Cambridge, is the new Challis Professor of Engineering. A Canadian, Professor Roderick is regarded as one of England's foremost authorities on the behaviour of metal structures and on the design of welded steelwork and aluminium alloy structures.

Professor C. E. Marshall, after the completion with members of his department of the first systematic geological survey of the Solomon Islands, is preparing a geological traverse east-west across Australia. To be undertaken in July, this traverse will give information on the variations of the Earth's gravitational and magnetic fields.

The Chemistry Department has completed the installation of a Raymax X-ray Analysis Unit. Manufactured in Manchester, England, the Metropolitan-Vickers outfit is one of the most modern diffraction units in Australia. The all-metal tube is demountable, enabling any of several targets to be used. The maximum tube current is 30 milliamps and the maximum peak voltage 100 kilovolts. There are two aluminium windows.

Another recent acquisition of the Crystallographic Section is a Unicam Weissenberg Camera. This precision instrument, together with two Unicam rotation cameras, two Unicam powder cameras, card index, Beevers and Lipson strips, and calculating machine, gives the small Section, under the leadership of Dr. D. P. Mellor, a formidable set of tools with which to attack the problem of crystal structures, especially those of co-ordination compounds.

Ph.D. Degrees, University of Sydney

Three members of the staff of the University of Sydney recently received the degree of Doctor of Philosophy—one within the Faculty

of Engineering and the others in the Faculty of Science. These were the first Ph.D. degrees to be conferred by the University of Sydney.

The first recipient was William Henry Wittrick, M.A., senior lecturer in Theory of Aircraft Structures, who obtained his Master of Arts degree at Cambridge and came to Sydney in 1945. Working under Professor A. V. Stephens, Professor of Aeronautical Engineering, he has produced a thesis entitled 'Torsion and Bending of Swept and Tapered Wings with Ribs Parallel to the Root'. His degree was conferred at the ceremony held in the Great Hall at the University of Sydney on Saturday, 28 April 1951.

The second degree was conferred on George Frederick Humphrey, Master of Science of the University of Sydney, who is senior lecturer in Biochemistry. During 1947 Dr. Humphrey worked at Cambridge University with Dr. Mann on the biochemistry of fertility. His thesis was entitled 'The Metabolism of the Adductor Muscle of Saxostrea Commercialis'.

The first woman to receive a Ph.D. degree from the University of Sydney is 26-year-old Hungarian chemist, Eleanora Clara Gyarfas, M.Sc. Dr. Gyarfas's thesis was entitled 'Studies in the Chemistry and Optical Properties of the Complexes of Iron, Ruthenium, Osmium and Nickel with 2:2'-dipyridyl and (1, 10),-phenanthroline'. She is the first chemist to investigate the complex compounds of the rare metal osmium. Dr. Gyarfas is a graduate of Budapest University. She has worked under a Commonwealth Research Scholarship at the University of Sydney since she arrived in January 1948.

The Societies

Royal Society of New South Wales

April: W. H. Robertson, Occultations observed at Sydney Observatory during 1950.

F. R. Morison (presidential address), The Science Museum—Its Duties and Dues.

May: W. B. Smith-White, An elementary non-conservative electrical system.

C. A. M. Gray, The analysis of infinitely long beams under normal loads.

A. E. Alexander (lecture), Colloids.

Royal Society of Victoria

April: J. D. Brookes (lecture), An investigation on the water economy of the Wallaby Creek basin.

May: G. F. Walker (lecture), Soil Mineralogy at the Macaulay Institute, Aberdeen, Scotland.

Royal Society of Western Australia

April: R. W. Fairbridge (lecture), The Snowy Mountains hydro-electric scheme.

Royal Society of Tasmania

April: J. B. Polya (lecture), The chemotherapy of cancer.

May: J. Reynolds, The building of the Australian Federation.

Medical Sciences Club of South Australia

April: S. G. Tomlin (lecture), Cell membranes.

May: J. S. Robertson, Developments in rabbit ear chamber techniques.

Royal Society of Queensland

April: M. F. Hickey (presidential address), Form or Function.

May: H. J. Wilkinson (lecture), Prehistoric settlement by Man of the Pacific Islands.

International Conferences

1951

June 4-15—Joint Conference, Institutions of Civil, Mechanical and Electrical Engineers, London.

June 18-July 7—VI Session, UNESCO General Conference, Paris.

June 27-July 3—II General Assembly, I.U. Crystallography, Stockholm.

July—IV Congress of the Sea, Ostend.

July—I.U. Pure and Applied Physics, Symposium on Ultrasonics and Molecular Structure, Brussels.

July—Mathematical Colloquium, St. Andrews, Scotland.

July 6-10—Nuclear Physics Congress, I.U. Pure and Applied Physics, Copenhagen.

July 11-14—General Assembly, I.U. Pure and Applied Physics, Copenhagen.

July 16-21—XIII International Congress of Psychology, Stockholm.

July 26-31—Conference on Automatic Control, Cranfield, England.

July 23-25—Conference on Dielectrics, Liverpool.

August—International Congress of Applied Psychology, Goteborg, Sweden.

August—International Astronomical Union, Symposium on Problems of Astronomical Instrumentation, and on Astronomical Problems of Radio-Astronomy, Stockholm.

August—I.U. Biological Sciences, Symposium on Symbionts in Insects, Amsterdam.

August 1-8—VIII General Assembly, International Astronomical Union, Leningrad.

August 13-15—Joint Commission on Radiometeorology, Brussels.

August 17-24—IX International Congress of Entomology, Amsterdam.

August 21-September 1—IX General Assembly, I.U. Geodesy and Geophysics, Brussels.

August 29-September 11—Conference on Refrigeration, London.

September—Joint Commission on Oceanography.

September 8-17—XII Congress and XVI Conference, I.U. Pure and Applied Chemistry, Washington and New York.

September 10-13—II Congress, I.U. Leather Chemists' Societies, London.

September 11-13—Discussion on Heat Transmission, London.

September 11-20—Building Research Congress, London.

September 15-21—V Congress, International Scientific Film Association, The Hague.

October 15-19—World Metallurgical Congress, Detroit, U.S.A.

December—II Congress on Industrial Medicine, Rio de Janiero.

December—I.U. Biological Sciences, Symposium on Biometric Problems in Relation to Growth of Plants, New Delhi.

1952

April 29—V International Hydrological Congress, Monaco.

July—International Congress of Zootechnics, Copenhagen.

July 22-28—II International Congress of Biochemistry, Paris.

August 4—International Congress on Analytical Chemistry, Oxford.

August 8-15—XVII International Geographical Congress, Washington.

August 15-September 15—International Congress for Applied Mechanics, Istanbul.

September 3-5—VI General Assembly, International Council of Scientific Unions, Amsterdam.

Summer 1952—I.C.S.U. Joint Commission on High Altitude Research Stations, Colorado, U.S.A.; I.C.S.U. Joint Commission on Spectroscopy, Columbus, U.S.A.; I.C.S.U. Joint Commission on Ionosphere, Australia; X General Assembly, International Radio-Scientific Union, Australia; International Geological Congress, Algiers.

Letters to the Editor

The Editorial Committee invites readers to forward letters for publication in these columns. They will be arranged under two headings: (*a*) Original Work; (*b*) Views.

The Editors do not hold themselves responsible for opinions expressed by correspondents.

Original Work

The Nature of Gilgai and Melon-hole Soils

The gilgai and related phenomena have been described several times in Australian soils literature since the account given by Prescott (1932). Over the last four years field and laboratory investigations into the distribution and nature of soils showing gilgai features have been made in these laboratories. They have been found to occur in a wide variety of formations, and under rainfalls varying from seven inches to 70 inches. We have examined their chemical character, mechanical composition and clay mineralogy as well as the climatic and topographic limitations to their development in the field.

From these studies we have found only one characteristic that is common to all formations, and which distinguishes all soils showing gilgai phenomenon from those which fail to show it. This distinguishing property is best termed the 'swelling' profile.

From measurements of the extent to which the soil swells when wetted, it appears that, for gilgais to form, the swelling profile must show two features. In the first place, the top-soil must show not less than a certain minimum swelling capacity (about 10 per cent.); and in the second place, the deep subsoil must have a greater swelling capacity than the top-soil.

The greater swelling capacity of the subsoil is associated with an increase in the clay content, an increase in the exchange capacity of the clay, and an increase in the proportion of sodium ions on the exchange complex; and partial regression analysis has shown that each of these properties is significantly correlated with the swelling capacity of a soil.

Field observations have shown that no gilgai or melon-hole formations have been found to occur on light-textured surface soils. On the other hand, not all heavy-textured soils show gilgai features; but in these cases it has been found that there is little difference in the swelling capacity of subsoil and top-soil. Examples of this are the 'self-mulching' soils showing no gilgai features.

Although the complex nature of the problem has prevented a rigorous statistical analysis of the relationship between profile characteristics and the amplitude of the undulations produced, the evidence suggests that, other things being equal, the higher the clay content of the profile the smaller will be the vertical interval between 'puff' and 'shelf'.

A full account of these studies will be published elsewhere, but this preliminary note is given because of the impending departure from this country of both authors, which may delay final publication.

E. G. Hallsworth,
Gwen K. Robertson.

Agricultural Chemistry Laboratories,
University of Sydney.
23 April 1951.

Reference

Prescott, J. A. (1932): The Soils of Australia in Relation to Vegetation and Climate, C.S.I.R. Bull. No. 52.

Views

Land Systems and Large-scale Mapping

In a recent issue of the *Regional Development Journal* (February 1951), in that section devoted to Land Research, it is stated that the mapping unit for large-scale survey in undeveloped regions is the *Land System*, defined as 'an area in which there is a recurring pattern of topography, soils and vegetation'. The usefulness of such a concept in large-scale survey is undoubted. However, it is by no means universally applicable, for it excludes complex areas in which there is no 'recurring pattern of topography, soils and vegetation', and it obscures the identity of units of the one land type large enough to be mapped separately; it includes within its scope 'recurrent patterns' which, logically, should be separated.

These comments can be illustrated in a consideration of the following terms, provisionally used by the writer in a recent study in North Queensland, which are presented for criticism. A detailed discussion will be presented in a later publication.

Thus there are *Land Types* on uniform parent material in which there are no recurrent patterns of soils and vegetation, both being uniform or showing only slight variation throughout; as in the rolling to undulating jungle-clad Red Loams of the basaltic Atherton Tableland, or the precipitous jungle-covered schist ranges near Cairns, or the gently undulating *Astrebla lappacea* grassland on heavy-textured alkaline soils in north-west New South Wales (described by Beadle, 1948).

There are other areas forming *Land Complexes* in which different elements are so mixed that there is no recurrent pattern of topography, soils and vegetation, owing either to the nature of the parent rock or the random occurrence of parent materials differing lithologically and/or in age. The following examples from North

Queensland are typical. In the middle course of the Einasleigh River, warping of a residual laterite surface on Jurassic sandstone with later dissection has given a complex in which at least six elements occur in almost any association with one another. South and west of Mount Garnet is an intimate mixture of granite with and without laterite remnants, quartzites and phyllites, in broken rolling-to-hilly lands with occasional flats, marked by extreme diversity of vegetation. East of Einasleigh is a complex on a basalt series of late Tertiary to Recent age, the older flows residual, and dissected (with renewed pedogenesis), mixed with later flows of varying basicity carrying different soils and vegetation.

Within the broad category *Land Systems*, subdivisions seem desirable; certainly all of the following are distinctive and have been recognized and mapped in North Queensland on a scale of 1:1,000,000.

Catena.—A simple slope unit on uniform parent rock, with complementary changes in topography, soils and usually vegetation from the highest to the lowest members of the unit, each member being regarded as the product of its site and the more elevated members of the unit. The realization that Milne's catena concept has a higher status than a unit of mapping convenience, evident in numerous papers, notably Morison (1948), supports the view that it may be used as a separate entity in land classification.

*Land Lenken.**—An area in which the parent rock is uniform and the topography consists of a linked sequence of hills grading into rolling and then undulating surfaces in which the soils and vegetation vary with their topographic location in the sequence.

Land Associations.—Several types may be recognized. A simple association of two or more recurrent, usually unrelated, elements which are neither catenary nor lenken in form, such as the heavily wooded sand beach ridges overlying *Sporobolus* grassland on clays of past tidal origin, Gulf of Carpentaria. A *Catena-Association* where, of two or more recurrent elements, one at least is catenary within itself, such as a mesa-studded plain, the mesa caprock carrying different soils and vegetation from the surrounding catena. A *Lenken-Association* where, of two or more recurrent elements, one at least is lenken within itself. The association of a lenken with wide alluvials is an important intermediate in North Queensland between a lenken, with only minor creek flats, and the very wide alluvial plains near the Gulf of Carpentaria, which may be mapped separately.

The above units, and their definitions, are relative only to large-scale survey. Some may be used on a smaller scale, but others are simply convenient pigeon-holes for complex units which cannot be separated at the scale of mapping.

DAVID S. SIMONETT.

Department of Geography,
University of Sydney.
3 May 1951.

* From the German *Lenken*, to bend; *Gelenk*, a link of a chain.

References

The Regional Development Journal (1951): 2, 1, 43, Canberra.

BEADLE, N. C. W. (1948): The Vegetation and Pastures of Western New South Wales. Sydney: Government Printer.

MILNE, G. (1935): *Soil Res.*, 4, 183-198.

MORISON, C. G. T. (1948): *Comm. Bureau Soil Sci.*, Tech. Comm. 46, 124-128.

Reviews

Ballistics

INTERNAL BALLISTICS OF SOLID-FUEL ROCKETS. Military Rockets using Dry-processed Double-base Propellant as Fuel. By R. N. Wimpress. (New York: McGraw-Hill, 1950. 214 + xiii pp., 121 text-figs., 30 tables. 5¾″ × 9″.) Price, $4.50.

The renaissance of the artillery rocket was one of the outstanding armament developments during the Second World War. On the side of the Allies a leading part in this development was played by a group working at the California Institute of Technology. A member of the group has now compiled a record of their theoretical treatments and practical experience of the various aspects of rocket motor design and performance. Much of the information has been presented previously only in unpublished reports.

The book is concerned principally with solventless-processed double-base smokeless powder rockets of relatively short burning time, but there is some information on other solid propellants. After discussing the burning properties of propellants, gas flow and nozzle performance and the determination of reaction pressures, the author deals at some length with the design of propellant 'grains'; the effect of the physical properties of the propellant on ballistic performance; and heat transfer within the motor. There are short chapters on ignition and on static testing equipment. The theoretical treatment is fully illustrated by actual performance data, and the causes of discrepancies are discussed.

This book will be of great interest and value to specialists working in its rather narrow field; outside this restricted circle it may have little appeal.

M. W. WOODS.

THEORY OF THE INTERNAL BALLISTICS OF GUNS. By J. Corner. (New York: John Wiley; London: Chapman and Hall, 1950. 443 pp., numerous text-figs., tables. 5¾″ × 9″.) Price, $8.00.

The development of theoretical interior ballistics has proceeded rapidly in recent years, due mainly to the impetus of the war and the consequent demand for new and improved types of weapons and new experimental methods of research. On the theoretical side, one of the most active workers has been J. Corner—particularly in those aspects of ballistics depending on the theory of burning and the thermochemistry of propellants. His book, *Theory of the Interior Ballistics of Guns*, is the first book in English and the most up-to-date in any language containing an adequate treatment of modern theoretical methods in interior ballistics—particularly as the author has included much of his own wartime work and is conversant with most of the developments in his subject, including much hitherto unpublished material.

Dr. Corner has aimed at illustrating methods of attack on ballistic problems rather than presenting final conclusions, and the result is a logically developed and well set out account of theoretical interior ballistics as applied to guns. At the same time, there is continual appeal to experimental results, both as a check on the theory and to suggest further avenues of approach.

The first chapter outlines the field of interior ballistics, the history of its development and the various methods used to measure gun pressures and muzzle velocities. The next discusses theories of the burning and erosion of propellants. Then follows an account of the thermochemistry of propellants and its application to experimental ballistic research. The next three chapters deal with the methods of attacking ballistic problems, starting with simple methods and empirical corrections used with them, and proceeding to the more advanced methods and to the questions of similitude and optimum problems. Then come two chapters dealing with the application of these methods to leaking guns and the modifications necessary for special types of gun. Finally, hydrodynamical problems and the question of heat transfer to gun barrels are discussed.

Interior ballistics is a highly specialized subject and this book is therefore of relatively limited interest. It represents a notable contribution, however, to the all too scanty literature of the subject, and can be recommended with confidence to all persons interested in theoretical ballistics.

W. M. Harper.

Botany

An Introduction to the Embryology of Angiosperms. By P. Maheshwari. (New York: McGraw-Hill, 1950. 453 pp., 216 text-figs. 6″ × 9″.) Price, $6.00.

No comprehensive treatise, incorporating the vast amount of research published on angiosperm embryology, has appeared in the English language since the publication of Coulter and Chamberlain's *Morphology of Angiosperms* in 1903. In the book under review, Maheshwari has put together, in a well-written style, the present state of knowledge of angiosperm embryology. It is appropriate that he should be the author of such a book, for he has himself contributed much to this special branch of botany. This book is in fact one of the most satisfying texts that has been written in recent years on special botanical subjects. It is a good textbook and reliable reference book for both students and research workers in botany. The selection of illustrations for the text is to be strongly commended, and their reproduction is excellent.

The first chapter deals with the history of the development of the knowledge of angiosperm embryology and related subjects. Then follows a chapter each on the microsporangium, the megasporangium, the female gametophyte, the male gametophyte, and fertilization, all concerned with the processes leading to the central thesis of embryology.

In the study of embryology a consideration of endosperm and embryo development are closely linked. Before dealing with the embryo there is therefore a chapter on the endosperm. The contents of this are very good and the author has presented the correct concept of endosperm function, namely that the importance of endosperm is in embryo development, and not so much as a food reserve in seeds as is so frequently stated in many texts on botany. In this chapter the types of endosperm formation are considered, as well as the relationships between different types of endosperm, the histology of the endosperm and the phenomena of xenia, and mosaic endosperm.

Then there is a chapter on the embryo, which is a very clear descriptive treatment of the present-day knowledge of the subject. The different types of embryo development found in the dicotyledons and monocotyledons are described, with an account of what is known today of abnormal embryo development. There follows a chapter each on apomixis and polyembryony, both being important aspects of embryology in angiosperms. These two chapters should be helpful to the plant geneticist, as would be the next two chapters, which are concerned with embryology in relation to taxonomy and experimental embryology respectively.

The book concludes with a chapter on theoretical considerations, which presents the main philosophical interpretations put forward at various times on such topics as the male gametophyte, the female gametophyte, fertilizations, endosperm, and embryo. Except for this last chapter, the text is concerned with facts, and the value of the text is therefore not lost by philosophical excursions or by the author's own point of view. The book can be confidently

recommended to students and all who are interested in pure and applied botany.

N. H. WHITE.

BOTANICAL NOMENCLATURE AND TAXONOMY. Edited by J. Lanjouw. *Chronica Botanica*, *12*, 1-2. (Waltham, Mass: Chronica Botanica, 1950. 87 + vii pp., 1 photo. 7″ × 10¼″, paper covers.) Price, $2.50.

The editor of this work is Professor of Systematic Botany in Utrecht University and at the very centre of international activity on his subject; the volume has three sections, but is primarily the report of proceedings of a small international symposium on problems of botanical nomenclature and taxonomy at Utrecht in 1948. The second part contains two short supplements, one concerning the improvement of the machinery for conducting the international work on plant taxonomy, and the other giving lists of members of the Special Committees for Nomenclature. The third part of the volume contains Sprague's long-awaited official account of changes made to the International Rules of Botanical Nomenclature at the VI International Botanical Congress in Amsterdam, 1935, now published for the first time, apart from the slightly different mimeographed edition issued in 1948 for the Utrecht delegates. There are also appropriate illustrations, title-page facsimiles of previous editions of the Rules, and an index to plant names.

To return to the main part of the volume, the Minutes of the Utrecht Conference; they are the proceedings of a group of about twenty experts called together in response to the need to prepare some of the work on nomenclature for the guidance of the VII International Botanical Congress in 1950 (delayed since 1940 by the War). Their task was to consider under each article of the Rules the published and unpublished proposals for alteration which had accumulated since 1935 from groups and individual botanists all over the world; there were several proposals for almost every one of the 74 articles. The large set from American taxonomists was very carefully prepared and was presented by Dr. Rickett.

The value of these Minutes to the reader, then, is to admit him to a select discussion about the shortcomings and improvement of the Rules; certainly only specialists will appreciate it, but to them it is most instructive. The volume should be considered as one of the chronological series listed below, published since 1947, dealing with successive trends and changes of the Rules. Scarcely anything comprehensive appeared during the World War decade immediately preceding, and we are grateful to the publishers for this account.

Cognate Works

CAMP, W. H., RICKETT, H. W., and WEATHERBY, C. A. (1947): International Rules of Botanical Nomenclature. *Brittonia* 6: (1). (Reprinted Chronica Botanica Co. 1948.) An up-to-date but unofficial edition of the Rules; reviewed in This JOURNAL, April 1950.

LANJOUW, J. (1950): The volume here reviewed referring to events of 1948.

CAMP, RICKETT and WEATHERBY (1949): Proposed changes in the International Rules of Botanical Nomenclature, Sponsored by a group of American Taxonomists. *Brittonia* 7: (1).

LANJOUW, J. (1950): Synopsis of Proposals concerning the International Rules . . . submitted to the Seventh Int. Bot. Congress—Stockholm, 1950. Utrecht.

DE WIT, H. C. D. (1950): Changes in the International Rules of Botanical Nomenclature made by the Seventh Int. Bot. Congress at Stockholm. Reprint from *Flora Malesiana Bull. No.* 7. An unofficial review published within four months after the Congress.

We now await the official reports of the VII International Botanical Congress.

C. M. EARDLEY.

Chemistry

FUNDAMENTALS OF PHYSICAL CHEMISTRY FOR PREMEDICAL STUDENTS. By H. D. Crockford and S. B. Knight. (New York: John Wiley; London: Chapman and Hall, 1950. 366 + xi pp., 68 text-figs., 42 tables. 5½″ × 8½″.) Price, $4.25.

This book is an excellent compendium of utility physical chemistry, not only for premedical students but for any student, such as an engineer who, after a rapid and intensive course in general chemistry, finds that he must then 'specialize' in the restricted chemistry of his own profession. Not only must such a student have his general principles soundly established, but he requires a text-book where important finer points that tend to be forgotten can be quickly revitalized. This is such a book.

The reviewer feels happier about the larger section—from Chapter 6 to the end—based principally on the ionic theory; this is really well done: but less satisfied with the earlier, more fundamental, chapters. Chemistry has probably come easily to lecturers in the subject and to writers of chemical text-books. They tend to forget, or do not know, what a difficult struggle has gone on in the minds of very many students before there has developed a clear conception of the atomic idea and its consequences. Teaching for examinations, even when it is good teaching, concentrates on factual matter, not principles. When the teaching has been less satisfactory, with careless use of symbols and ideas, there is only one person who can repair the damage, and that is the student himself. Such a student will then probably find his way to the Science Faculty, not Medicine or Engineering.

It is to be regretted that much more importance was not given in the earlier chapters to Avogadro's Theory and the developments from it. This basic concept of chemistry has largely

been taken for granted, and therefore the textbook is scarcely correctly entitled '*Fundamentals* of Physical Chemistry'. It is, however, an excellent summary.

No serious errors were noted, and few small ones.

J. J. BROE.

Colloids

COLLOID SCIENCE. Volume 2: Reversible Systems. Edited by H. R. Kruyt. (New York: Elsevier, 1949. 753 pp., numerous text-figs. 10″ × 7″.) Price, $14.50.

The contributions which Dutch science has made to the general realm of Colloids has always been a notable one. During the war, Professor Kruyt and a number of his colleagues took upon themselves the task of writing what they term 'a guide to the domain of Colloid Science with the object of providing a stimulus in the branch of research with which it deals'. Owing to accidental circumstances, Volume II was completed before Volume I, and was thus published first. The absence of Volume I, which deals with the irreversible systems (i.e., chiefly hydrophobic colloids), makes it impossible to review the work as a whole. However, the chapter headings and authors of Volume I are given as follows:

I.—General Introduction, H. R. Kruyt with the collaboration of J. J. Hermans.
II.—Phenomenology of hydrophobic systems. J. Th. G. Overbeek.
III.—Optical properties of colloidal systms, G. H. Jonker.
IV.—Electrochemistry of the double layer, E. J. W. Verwey and J. Th. G. Overbeek.
V.—Electrokinetic phenomena, J. Th. G. Overbeek.
VI.—The interaction between colloidal particles, J. Th. G. Overbeek and E. J. W. Verwey.
VII.—Kinetics of flocculation, J. Th. G. Overbeek.
VIII.—Stability of hydrophobic colloids and emulsions, J. Th. G. Overbeek and E. J. W. Verwey.
IX.—Rheology, G. H. Jonker.
X.—Miscellaneous subjects, G. H. Jonker, J. Th. G. Overbeek and E. J. W. Verwey.

Volume II, Macromolecular and Association Colloids, deals with the *reversible* systems and contains the following fourteen articles:

I.—A Survey of the Study Objects of this Volume, by H. G. Bungenberg de Jong.
II.—The Formation and Structure of Macromolecules, by R. Houwink.
III.—Thermodynamics af Long-chain Molecules, by J. J. Hermans.
IV.—The Physical Properties of Randomly Kinked Long-chain Molecules, by J. J. Hermans.
V.—The Determination of the Molecular Weight of Macromolecules, by J. J. Hermans and P. H. Hermans.
VI.—Macromolecular Sols without Electrolyte Character, by R. Houwink.
VII.—Sols of Macromolecular Colloids with Electrolytic Naturé, by J. Th. G. Overbeek and H. G. Bungenberg de Jong.
VIII.—Crystallisation-Coacervation-Flocculation, by H. G. Bungenberg de Jong.
IX.—Reversal of charge phenomena. Equivalent weight and specific properties of the ionized groups, by H. G. Bungenberg de Jong.
X.—Complex colloid systems, by H. G. Bungenberg de Jong.
XI.—Morphology of Coacervates, by H. G. Bungenberg de Jong.
XII.—Gels, by P. H. Hermans.
XIII.—Solid macromolecular systems with one (chemical) component, by R. Houwink.
XIV.—Association colloids, by H. L. Booij.

Like all such composite volumes it suffers from variations in the depth of treatment and in the integration of the various topics. A reader not already reasonably conversant with the field will probably find it very heavy going. On the other hand, research workers in Colloids will certainly find it of considerable value, for the literature is generally well covered up to 1947. Unlike so many recent books on polymers, it gives appropriate attention to the contributions from European sources.

A great deal of the book is taken up with the work of Professor Bungenberg de Jong's school on Coacervates; this is certainly the most detailed account of the subject available in the English language.

The translation (from the original Dutch) would seem to be very adequate, although there are a few occasions where the terminology is rather surprising (e.g., on page 42, the initiation reaction in polymerization is referred to as the 'start reaction').

Assuming that Volume I does not differ materially in its standards from Volume II, which would seem very probable in view of the authors, the reviewer would certainly recommend the purchase of *Colloid Science* to all departmental libraries. On the other hand, few chemists would find it of sufficient value to warrant purchase for their private libraries.

A. E. ALEXANDER.

Electronics

IONIZATION CHAMBERS AND COUNTERS. By D. H. Wilkinson. Cambridge Monographs on Physics. (Cambridge: University Press, 1950. 266 + x pp., 79 text-figs., 10 tables. 5½″ × 8½″.) English price, £1. 5s. net.

IONIZATION CHAMBERS AND COUNTERS: EXPERIMENTAL TECHNIQUES. By B. Rossi and H. H. Staub. National Nuclear Energy Series, Division V, Volume 2. (New York: McGraw-Hill, 1949. 243 + xviii pp., 140 text-figs., 8 tables. 5¾″ × 9″.) Price, $2.25.

In recent months several books and an abundance of articles on electrical counting devices have appeared. The two books reviewed here both form valuable additions to the literature on this subject.

In *Ionization Chambers and Counters* Dr. Wilkinson discusses first the basic phenomena on which the operation of gas-filled electrical detectors depends. After a short opening chapter in which the roles of three devices—the ionization chamber, the proportional counter

and the Geiger counter—are distinguished, the author includes a useful chapter in which the basic facts relating to the ionization of gases by charged particles are considered. Phenomena governing counter behaviour are then discussed, the topics including heavy ion and electron mobilities, diffusion effects, multiplication and recombination. Next follows a chapter which deals at some length with formation of pulses, and the pulse shapes to be expected with various detectors. The next three chapters, which form the most substantial part of the book, are devoted respectively to the ionization chamber, the proportional counter and the Geiger counter. In these chapters comprehensive accounts are given of the behaviour of the three types of detector, considerable emphasis being placed on recent research into counter and ionization chamber operation. A short space only is allotted to discussion of practical details of construction of the various devices. The last chapter summarizes some pertinent facts concerning counting speed and statistics. The book concludes with a four-page list of relevant references. In this book the reviewer found the frequency with which the author refers the reader, particularly in the earlier chapters, to subsequent or previous sections of the book for explanations or amplification of statements somewhat irritating.

The book *Ionization Chambers and Counters: Experimental Techniques* is as welcome and useful as its predecessors in the National Nuclear Energy Series. In this book Rossi and Staub devote the first hundred pages to consideration of the basic physical phenomena underlying operation of the devices. In this part of the book a marked emphasis on ionization chambers is noticeable. In the second portion of the book a variety of ionization chambers and counters are described; most of them, according to the preface, were developed at the Los Alamos laboratory. The detectors are not considered according to their type, but they are grouped according to the type of radiation they are designed to detect. Thus beta-ray, gamma-ray and X-ray detectors are described in one chapter, alpha-particle detectors in the following chapter, then follow chapters dealing with detectors for neutron recoils, detectors of (n,α) and (n,p) reactions, and fission detectors respectively. In each of these five chapters several devices are discussed, the accompanying detailed diagrams with adequate footnotes in explanation of constructional details being a valuable feature. The data given in various tables throughout the book and in the appendix (range-energy relations, scattering cross sections, attenuation co-efficients for γ-rays, etc.) enhance the value of the book. Only a few references are given.

While both the books are of considerable value to those wishing to understand the operation of ionization chambers and counters, it is felt that the second one will be of far more practical use. Those wishing to construct ionization chambers or counters for specific researches are likely to find the detailed information given by Rossi and Staub of great value in designing and operating their own equipment.

Both books are well produced, and are good value in relation to their price. In fact, the comparatively modest price at which *Ionization Chambers and Counters: Experimental Techniques* is sold locally makes it a particularly good bargain.

J. C. Bower.

Geology

Introduction to Theoretical Igneous Petrology. By E. E. Wahlstrom. (New York: John Wiley; London: Chapman and Hall, 1950. 365 pp., numerous text-figs. 5½" × 8½".) Price, $6.00.

This book is a fitting companion to the other two recent books by Professor Wahlstrom, on *Optical Crystallography* and *Igneous Minerals and Rocks*, and with them constitutes a set which should be of the greatest value to the advanced student in geology.

Theoretical Igneous Petrology is a text on petrogenesis which brings together information concerning the origin of the igneous rocks which is otherwise obtainable only in research papers scattered through numerous scientific periodicals, and the use of this text by senior students in geology will reduce considerably the wear and tear on these valuable and often irreplaceable journals. All aspects of igneous rock formation—physico-chemical, geophysical, field occurrence, and the broader aspects of earth structure—are given due consideration in this synthesis. Physico-chemical data is quoted to support theory on every question discussed, and for the student who has had little experience of physical chemistry a most useful appendix, entitled 'Physico-chemical concepts useful to the petrologist', is given.

The various theories of magmatic differentiation, granitization, assimilation and syntexis, which have been advanced to account for the variation in character of the igneous rocks, are discussed fully and without bias; except perhaps that much-argued question of granitization, in which the author tends to lean more towards the magmatist school. A very useful feature of the book is the lists of references at the end of each chapter, from which the student can find the most significant papers to consult should he wish to delve more deeply into the matters discussed in the book.

This book is well illustrated by line diagrams. The reviewer feels that the diagrams illustrating crystallization in ternary systems (e.g., on pp. 32-34) could have been improved by a modification of the small insets, so that they would represent the base of the triangular prism with the vertical sides thrown open; so

that the base of the side diagrams coincides with the appropriate side of the triangular base of the prism instead of being inverted as shown in the published text-figures. There is an unnecessary complication in the numbering of the figures which is arranged according to the order of appearance in each chapter; thus when referring to a figure in the text it is necessary to quote also the number of the page on which it appears.

A few typographical errors were noted, such as in the caption to Figure 6 on page 147 where the date 1924 should read 1917. Again, on page 150 the date of publication of a paper is given as 1929 in the heading of Table 6 whereas only three lines above this the date of publication of the same paper is given as 1924. Also, the final line in the caption to Figure 1 on page 241 is incorrect, as are the first two lines on page 280. These few inconsistencies do not, however, detract from the attractiveness of this book, which, because of its excellent and thoroughly up-to-date coverage of the field of igneous petrogenesis, can be recommended most highly to any advanced student in petrology.

REX T. PRIDER.

Geophysics

EARTH WAVES. By L. Don Leet. Harvard Monographs in Applied Science, No. 2. (Harvard: University Press; New York: John Wiley, 1950. 122 pp., 58 text-figs., 10 tables. $5\frac{1}{2}'' \times 8\frac{1}{2}''$.) Price, $3.00.

During the twentieth century, seismology with related work on seismic prospecting and foundation engineering has developed from crude qualitative beginnings to a science in which many results of good precision are obtainable. The point has possibly been reached where some theory of Earth waves might well form part of regular undergraduate training in Physics. The book under review, whose author is a distinguished authority on practical seismology, contains only elementary mathematics and could serve as an introduction to Earth waves that could be easily followed by second-year students of Physics in Australian universities.

The first chapter gives the elementary theory of forced vibrations and describes the principle of the seismograph and seismic prospecting equipment. The second chapter refers to various theoretical and observed types of seismic waves. A long third chapter, occupying nearly half the book, considers in an elementary way the reflection and refraction of elastic waves and seismic travel-times, gives a broad picture of seismic waves in the Earth's interior, and discusses seismic prospecting in relation to various geological applications. The final, fourth, chapter presents a summary of work on microseisms with special reference to tripartite stations and the use of microseisms to forecast hurricanes.

The book is beautifully printed, is very readable, and has many clear diagrams. In the short space of its 122 pages the book could, of course, not go to great detail. Typical items that might, however, have been well included are (i) a statement that *just two* elastic parameters are needed in describing the elastic behaviour of a perfectly elastic isotropic body; (ii) reference to the Earth's *inner* core—whose existence has been well established by work of Lehmann, Gutenberg and Richter, and Jeffreys.

K. E. BULLEN.

Heat

INTRODUCTION TO THE TRANSFER OF HEAT AND MASS. By E. R. G. Eckert. (New York: McGraw-Hill, 1950. 284 + xii pp., 143 text-figs., 18 tables, 1 folding chart. $6'' \times 9''$.) Price, $4.00.

The author of this book is a German scientist now working in America. The phraseology, and even the title, read more like a translation than an original work in English. Its predecessor was a German text at the graduate level written seven years ago; but new topics such as regenerative heat exchangers and heat transfer at transonic and supersonic speeds have been introduced.

There are chapters on conduction and radiation, but the book is concerned principally with heat transfer by convection. The emphasis throughout is on the boundary layer as the seat of heat transfer from a solid to a fluid, and the problem is treated on the basis of Prandtl's boundary layer theory and von Kármán's momentum equations. The relationships between heat transfer and the exchange of mass are pointed out, and the final chapter deals with evaporation as an example of a mass-exchange process. It is unfortunate that space could not be found for the treatment of other similar processes, such as the solution of a solid in a liquid and the more complicated phenomena of combustion.

The parallel treatment of heat transfer and mass transfer is, as far as the reviewer knows, unique. The value of this approach arises not only from the similarity of the concepts involved but also from the necessity, in many practical problems, to consider the two types of transfer simultaneously.

This book is a valuable contribution to the literature of heat transfer and fills a gap between the more elementary texts and detailed treatments whose emphasis is on practical problems and experimentally determined values rather than basic theory. It might well be used by final-year engineering students as a text on this important but often neglected subject.

M. W. WOODS.

Mathematics

THE THEORY OF ALGEBRAIC NUMBERS. By H. Pollard. Carus Mathematical Monographs, No. 9. (New York: John Wiley, for the Mathematical Association of America, 1950. 143 + xii pp. 5″ × 7½″.)

As stated in the preface, 'the purpose of this monograph is to make available in English the elementary parts of classical algebraic number theory', i.e., the extension of the arithmetic of the rational integers to the case of algebraic integers in an algebraic number field (a simple algebraic extension of the field of rational numbers).

A knowledge of linear algebra (theory of determinants and systems of linear equations), the fundamental theorem of algebra (factorization of a polynomial as product of linear factors) and the fundamental theorem of symmetric functions (representation of symmetric functions in terms of the elementary symmetric functions) are assumed; otherwise the text is self-contained and can be read without difficulty by an honours student. It is written clearly and carefully; the only disadvantage is a somewhat too economical and concise style. This is obviously dictated by the limitation in size of this type of monograph, but the reviewer feels that a few sentences of explanation here and there would greatly facilitate the study to the uninitiated student (e.g., the term 'Euclidean field' is introduced without explicit reference to the Euclidean algorithm). A more extensive index would add to the value of the text.

The scope of the text may be seen from the following table of contents: I. Divisibility. II. The Gaussian Primes. III. Polynomials over a Field. IV. Algebraic Number Fields. V. Bases. VI. Algebraic Integers and Integral Bases. VII. Arithmetic in Algebraic Number Fields. VIII. The Fundamental Theorem of Ideal Theory. IX. Consequences of the Fundamental Theorem. X. Class-Numbers and Fermat's Problem. XI. Minkowski's Lemma and the Theory of Units.

F. A. BEHREND.

Nuclear Science

NEW ATOMS. Progress and Some Memories. By Otto Hahn. (Amsterdam: Elsevier; London: Cleaver-Hume, 1950. 184 pp., 1 plate, 8 text-figs., 8 charts, 4 tables. 5¼″ × 7½″.) English price, 12*s.* 6*d.*

This book is a collection of articles based on lectures given on different occasions by one of the discoverers of nuclear fission and as such is of considerable interest. Chapter 1 is the lecture delivered at Stockholm, 13 December 1946, on the occasion of his receiving the Nobel Prize. This is a valuable first-hand account of events leading up to, and the manner of the discovery of, nuclear fission. The next chapter, which is based on a memorial lecture (commemorating the three-hundredth anniversary of the death of Papin), gives a very clear description of the uranium chain reaction and is of particular interest because of the light it throws on German work on this subject. Most readers will, however, wish it had thrown more light. Hahn states that: 'In 1942 it was known in Germany and America that it was practicable in principle to construct power sources for the utilization of nuclear energy. German nuclear physicists planned to develop such fission ovens. In America during the war attention was concentrated on the use of the uncontrolled reaction for making explosives of previously unknown power'. Having opened up the subject it is a pity that Hahn did not say more about it. For example, one would like to know whether Hitler and Goering were kept entirely in ignorance of the war-like potentialities of nuclear fission. If they were not, it is hard to believe that nuclear physicists would have been left alone to pursue their own courses. It may not have been appropriate to deal with this topic at length in the original lecture upon which Chapter 2 was based, but more could have been said when reprinting it in book form. There were precedents for doing this since additions have been made to other chapters.

One of the most valuable chapters is that dealing with artificial new elements (numbers 93-98), from which the book takes its title. It contains in a useful and concise form the important facts about these substances and is thoroughly up to date.

The last chapter, which might perhaps more appropriately have been put first, deals with the author's personal reminiscences from the earlier history of natural radioactivity. Limitation to natural radioactivity means that the period covered does not extend much beyond 1920. Because of the nature of the sources of the material upon which the book is based there is a certain amount of unnecessary repetition of subject matter. Typographical errors give evidence of hasty preparation of a book that will be read with great interest by all those whose concern is with nuclear physics and chemistry.

D. P. MELLOR.

Organic Chemistry

HETEROCYCLIC COMPOUNDS. Volumes 1 and 2. Edited by R. C. Elderfield. (New York: John Wiley; London: Chapman and Hall. Volume 1, 1950; 703 pp. Volume 2, 1951; 571 pp. 5¾″ × 9¼″.) Price, Volume 1, $11.00; Volume 2, $15.00.

The appearance of any new work on systematic heterocyclic organic chemistry is an event. Nothing approaching the great work of Meyer and Jacobson, which was published about thirty years ago, just after World War I, has

ever appeared in English, and, indeed, relatively few works of any kind on systematic heterocyclic organic chemistry have been published. The most recent was Morton's little volume, excellent in its own way but much too highly condensed and indigestible for the student commencing the study of heterocyclics. It is not to be wondered at, therefore, that the announcement of a whole new series of volumes under the general editorship of Robert C. Elderfield, of Columbia University, dealing systematically with many of the more important heterocyclic ring systems, should have been received with enthusiasm. The first two volumes are now to hand and some assessment of their merits can be made. The first volume is divided into nine chapters and the second into fourteen chapters. Each chapter, dealing with one specific system, is the work of a different specialist or group of specialists. There are, of course, very great advantages to be gained from this method, but it does lead to some unevenness in the writing and in the treatment. Some dissatisfaction may also be found with the principle adopted that 'if a given field has been the subject of adequate and critical discussion in available book form recently, this field will be the subject of somewhat less extensive treatment in the present volumes'. A series of relatively expensive volumes aiming to cover the field of heterocyclics—one of the great divisions of organic chemistry—and, as stated elsewhere in the preface to Volume 1, 'concentrating attention on the chemical principles dealing with the synthesis, properties and reactions of the compounds under discussion' should surely not omit important sections of the available knowledge merely because these have been recently reviewed elsewhere; otherwise the series should be better entitled 'Supplementary Heterocyclic Chemistry'! The reviewer was very dissatisfied with the account presented in Volume 1 of pyrrole chemistry in a mere 66 pages. Hollins, in his 1923 book *The Synthesis of Nitrogen Ring Compounds*, required sixty pages to discuss the methods then available for the synthesis of pyrroles. In the present account the subject is dismissed in a mere three and a half pages! Admittedly, references are given to the other accounts, but students desiring to have by them always a clear and reasonably complete picture of pyrrole chemistry would not get it from Elderfield. They would still be under the necessity of going to the reference library and having to plough through at least some German works.

If, on the other hand, the reader agrees with the Editor's principle, then little fault can be found with the material presented. Much of the work described in these first two volumes is recent, and adequate accounts have not appeared elsewhere. The reviewer particularly liked the account of pyridine chemistry in Volume 1, which presents most of the important features clearly and authoritatively.

The subjects discussed, together with the individual writers (shown in brackets) are:

Volume 1: Ethylene and trimethylene oxides (S. Winstein and R. B. Henderson); ethylenimine (J. S. Fruton); azete (S. A. Ballard and D. S. Melstrom); furan (R. C. Elderfield and T. N. Dodd, junior); thiophene (F. F. Blicke); pyrrole (A. H. Corwin); monocyclic pyrans, pyrones, thiapyrans and thiapyrones (J. Fried); pyridines, piperidines and partially hydrogenated pyridines (H. S. Mosher).

Volume 2: Benzofuran (R. C. Elderfield and V. B. Meyer); isobenzofuran, phthalan and phthalide (R. C. Elderfield); dibenzofuran (W. E. Parham); thionaphthene (D. K. Fukushima); dibenzothiophene (D. K. Fukushima); coumarins and isocoumarins (S. Wawzonek); chromones, flavones and isoflavones (S. Wawzonek); chromenols, chromenes and benzopyrylium salts (S. Wawzonek); chromanones, flavanones chromanols, and flavanols (S. Wawzonek); chromans, xanthones, xanthenes, xanthydrols and xanthylium salts (S. Wawzonek); fluorans, fluoresceins and rhodamines (S. Wawzonek); thiochromans and related compounds (D. S. Tarbell).

It will be seen that the second volume is devoted entirely to polycyclic oxygen and sulphur monohetero compounds—a field which has not previously been so comprehensively surveyed in a single volume.

There is little doubt that all heterocyclic chemists will welcome Elderfield. Having to select material because of space limitations will always lead to some dissatisfaction, but taken by and large the accounts presented in these new volumes are excellent and bound to attract more and more chemists into the heterocyclic field. Future volumes of the series will be awaited with eagerness.

F. LIONS.

Physics

ELECTROMAGNETIC FIELDS—THEORY AND APPLICATION. Volume I: MAPPING OF FIELDS. By E. Weber. (New York: John Wiley; London: Chapman and Hall, 1950. 590 + xvi pp., 180 text-figs., 14 tables. $5\frac{1}{2}'' \times 8\frac{1}{2}''$.) Price, \$10.00.

The subject of electromagnetic theory has been divided by the author into two fundamental branches, one dealing with static electric and magnetic fields, and the other with the dynamic interaction of electric and magnetic fields. This volume deals with the former subject.

A general knowledge of the electromagnetic field and of the principles of vector notation is assumed. The fundamental physical principles are summarized in the early chapters, followed in Chapter 4 by simple field solutions for simple geometrical arrangements of charges, current

loops, conductors, and coils. There follows in Chapter 5 a brief description of experimental field plotting methods, the most important being the electrolytic tank ('trough') and the rubber membrane analogues. Graphical and semi-graphical methods of field plotting are covered in detail in Chapter 6. The two final chapters, on two-dimensional and three-dimensional analytic solutions, comprise over one-half of the text and are outstanding. The subject is treated thoroughly, starting from first principles, and is carried through to the most complicated examples.

The main criticisms which can be made are on the relative emphasis given to the various items. For example, the important electrolytic tank is covered in six pages, and the resistive analogue is not mentioned. Throughout the text the main emphasis is on the mathematical approach. Very few actual field maps are given, and there is little emphasis on practical problems which can be solved by the various methods of field mapping which are outlined. Extensive references to books and original articles are given, however, throughout the text, on subjects not covered in detail.

This book can be recommended to the student and teacher as an excellent text on the subject of the mapping of fields. A large number of problems are given at the end of each chapter. For the engineer the main interest lies in the chapters on analytic solutions. If treated in a similar thorough manner, Volume II should prove of great interest, and the two volumes should form a useful reference and teaching text on an important subject.

R. E. AITCHISON.

Spectroscopy

PRACTICAL APPLICATIONS OF SPECTRUM ANALYSIS. By H. Dingle. (London: Chapman and Hall, 1950. 245 pp., 19 plates, 37 text-figs., 8 tables. 5¾″ × 9¾″.) English price, £2.

The book commences by being elementary. Simple ideas of atomic structure and energy levels in atoms are developed to explain where the light energy comes from, and how it gets absorbed again by atoms. Some sources of radiation are described, and the succeeding chapters are concerned with descriptions of prism spectrographs and diffraction gratings. Qualitative spectrum analysis is discussed in some detail, and *raies ultimes* of the principal elements are given to 0.001 Å. Quantitative spectrum analysis is briefly outlined with, one might say, commendable caution. There may be many, however, who will be disappointed with this chapter. Identification tables and plates complete the book.

This book is for the routine worker in spectroscopy, and would hardly interest the research worker in a more developing field.

T. IREDALE.

Statistics

CONTRIBUTIONS TO MATHEMATICAL STATISTICS. By R. A. Fisher. (New York: John Wiley; London: Chapman and Hall, 1950. Reprints of 43 published papers, with biography, photograph and index. 8¼″ × 11″.) Price, $7.50.

In many branches of pure science the twentieth century has been characterized by painstaking filling-in of the details of an already well-outlined skeleton. Exceptions are to be found readily, in the field of nuclear physics and the new drugs in medicine; but even here the startling developments have been primarily the result of team work of a number of people, even if only finally brought to fruition by the brilliant insight of an individual. Nor do any of the 'Great Names' of one field often appear again in the lists relating to the others. There is no Newton or Da Vinci among our scientists of today.

Yet if one were asked to nominate the person who had had influence in the widest fields and upon the greatest number of individuals, the candidature of R. A. Fisher would be a very strong one. He, more than any other man, was responsible for putting statistics on a sound mathematical basis, and his work there has not only won respect and gratitude from the mathematician but has given confidence to the workmen in other sciences, notably medicine and psychology, and in industry, who have felt that their tools are tested and guaranteed. The application of the methods developed by Fisher for the design and analysis of experiments in the biological field have opened up such possibilities of fruitful research, particularly in the agricultural field, that it is now difficult to believe that the technique is a bare thirty years old. In the field of mathematical genetics Fisher has provided a quantitative and mathematical basis for what had formerly been largely a speculative subject. Add to this revolutionary contributions to the philosophical theory of probability and the record is indeed impressive.

The present massive volume consists of reprints of 43 of the more important papers. Each is preceded by a short note by Fisher himself indicating what he regards as the special significance of the article, and its relation with others, including those not selected for publication here. This commentary is particularly interesting in showing the development not only of the problems being discussed but of Fisher's thought on the matter. The photographic reproduction technique, though it does not appear to have achieved success in conveying 'the flavour of the original papers as well as their content', does help very much in producing a feeling of intimacy with the author, for one is able to see the careful handwritten emendations and deletions that he has made to a number of articles.

The choice of papers for reprint seems very admirable; indeed, since it appears to be Fisher's own it could hardly be anything else. No point would be served by listing them here; it may suffice to say that all those earlier and less accessible ones developing the Chi-square techniques, dealing with problems of estimation and the maximum likelihood function, the techniques of field experiment, and those dealing with the philosophical problems of inference, are all included. Spice to the volume is added in the reprinting (No. 29) of one of Fisher's typically bitter attacks on what for many years he had regarded as the 'peevish intolerance of free opinion in others' of Karl Pearson; as a study in scathing criticism it still reads as well as when published.

The introductory biography of Fisher by Professor Mahalanobis, reprinted from Sankhyā, also deserves comment as a very well balanced assessment of his contributions to the subject, and provides a useful introduction to the volume. Finally, one must draw attention to the index. Faced with a new (or an old) problem, one's first question so often is, 'What has Fisher to say about it?': while his books provide some of the answers, those to the more unusual problems are always to be found in the articles, and until the appearance of the present volume and its admirable index they were difficult, if not impossible, to locate.

R. S. G. RUTHERFORD.

STATISTICAL DECISION FUNCTIONS. By A. Wald. (New York: John Wiley; London: Chapman and Hall, 1950. 179 + xi pp. 5¾" × 9".) Price, $5.00.

The work of A. Wald on sequential analysis is well known. In *Statistical Decision Functions* he has formulated a generalized theory of statistical tests, taking particular notice of von Neumann's *Theory of Games and Economic Behaviour*. For this generalized theory an extensive notation has been developed and from it many of the classical tests of significance and the sequential tests of significance are derived as special cases. The *a priori* distributions are given a place in the theory.

This book will be found difficult reading, but will doubtless be essential to anyone interested in the general theory underlying statistical practice and tests of significance.

H. O. LANCASTER.

Thermodynamics

THE CHEMISTRY AND METALLURGY OF MISCELLANEOUS MATERIALS: THERMODYNAMICS. National Nuclear Energy Series, Manhattan Project Technical Section. Edited by Laurence L. Quill. (New York: McGraw-Hill, 1950. 329 pp., numerous tables. 9¼" × 6".) Price, $3.00.

In his foreword to the National Nuclear Energy Series, A. H. Compton points out that in the long view of history the major human heritage from the discovery of atomic energy will probably not be the atom bomb or even a new source of power, but its contribution to the sum total of knowledge. After perusing some of the volumes of this series it is not difficult to accept this point of view. The sixty volumes planned contain or will contain information collected in the course of working out the processes for mass production of plutonium. The present one (Division IV, XIXB) is based on a collection of papers dealing principally with the physical and thermodynamic properties of miscellaneous inorganic substances, including the elements, common gases, halides, nitrides, sulphides, carbides and phosphides. The thermodynamic information presented on these substances is most complete, carefully assessed and thoroughly well documented. Essentially a reference book, it will be invaluable to all interested in pure or applied inorganic chemistry.

D. P. MELLOR.

Visual Education

VISUAL AIDS REVIEW. Issued by the Department of Visual Aids, University of Melbourne. Volume 1, No. 1. (Melbourne: University Press, August 1950. 40 pp. 6" × 9".) Price, 3*s*. 6*d*. net.

Teachers in Australian schools and universities will welcome the appearance of Volume 1 of a new periodical, *Visual Aids Review*, issued by the Department of Visual Aids, University of Melbourne. As the title of the journal implies, the articles range far and wide in reviewing the field of visual education, and offer many useful suggestions to those who are interested in the relations that should exist between teachers and taught.

The editor's choice of material for Volume 1, No. 1, is excellent and introduces the reader to C. Ogilby's 'The Production and Application of Photostencils', N. D. Anderson's 'Visual Aids in the Adult Class Room', E. R. Wyeth's 'Children and the Cinema: A Summary of a Survey', and to Manuel Gelman's 'Some General Ideas on Visual Aids in Modern Language Teaching'.

A number of short articles will have a very general appeal, dealing as they do with such widely different subjects as television in relation to education, the effective use of sound films, and the British Committee's searching inquiry into 'Children's Cinema Clubs or Matinées?'. Dr. M. C. Davis's recently produced film strip on 'Mitral Stenosis', with his own commentary, should prove of great interest to members of the medical faculty. For those who wish to keep in touch with overseas happenings there are reviews of new books and of publications dealing specially with the film and its teaching value in visual education.

E. A. BRIGGS.

Zoology

AUSTRALIAN SHELLS. By Joyce Allan. (Melbourne: Georgian House, 1950. 470 + xix pp., 44 plates, 12 of them coloured, 112 text-figs. $9\frac{1}{2}'' \times 6\frac{3}{4}''$.) Price, £3.

The aim of this book is to enable people to learn the names of the very varied types of mollusca likely to be encountered in any part of Australia and to find out something of their habits and where they are found; it also answers the general questions asked by visitors when consulting a museum conchologist. In all these aspects the book succeeds admirably and, indeed, exceeds its claims; for it embraces an enormous amount of information not readily available elsewhere and has the advantage of being illustrated mainly from Miss Allan's own water-colour and pen drawings of the animals and their shells. The distillation of years of study and experience, this is probably the most complete and up-to-date twentieth century work on the shells of any continent and it will prove of value to specialists in all parts of the world as well as to the amateurs for whom it was primarily prepared. The veriest novice is given helpful advice on making and arranging a collection. The authoress rightly stresses (page 42) the need for not unnecessarily destroying molluscan life, especially as dead shells are so easy to obtain.

About ten thousand different species of Australian shells are known, so those most commonly met with have been selected for description and illustration; but this selection has been so judicious that a virtually complete picture of the Australian mollusca (land, sea, freshwater, shelled and shell-less) emerges, only microscopic or very rare or obscure species being omitted. Any layman could confidently name most or all of the shells he may collect and he could have no better introduction to the fascinating hobby or study of conchology. No less than 1,240 species are illustrated (including some extralimital ones) and a glossary and index complete an excellent work. In future editions, no doubt, the plates will be numbered and such misprints as have crept in will be corrected, whilst some too literal vernacular names may be adjusted.

In choosing the correct scientific names Miss Allan steers skilfully between the Scylla of old-fashioned nomenclature and the Charybdis of the newer school, though her course involves some irregularities in generic classification, some slight sacrifice of numerical order, and some inappropriate genders of Latin adjectives for species-names which have been plucked from one genus to be grafted on another. But these are minor faults: the completion of this book is the culmination of the ambitions of several generations of Australian conchologists and is the more commendable when one considers the difficulties the authoress had to overcome. Blackouts, shifting of collections and laboratory accommodation and ill-health conspired to delay what was obviously a labour of love, even though she admits (page 370) 'I dislike the land shells intensely'. All the more praise is therefore due to Miss Allan for her magnificent effort, notably for the beautiful coloured plates, and congratulations are merited by the printers and publishers who have brought out this book, light in weight, clearly printed, and attractively bound and produced.

G. P. WHITLEY.

Book Notice

HANDBOOK OF CHEMICAL METHODS FOR THE DETERMINATION OF URANIUM IN MINERALS AND ORES. (London: H.M.S.O., 1950.) English price, 1*s*.

The value of mineral deposits containing uranium depends for final assessment on the results of chemical analysis. It is therefore essential that reliable chemical methods should be employed in this assay. The handbook, published for the D.S.I.R., describes procedures designed to deal with any type of ore containing from one-tenth per cent. uranium oxide to high-grade pitchblende which may contain 80 per cent. uranium oxide.

The recommended methods are based on the results of four years' experience at the Chemical Research Laboratory. They include new chromatographic techniques developed for the detection and determination of uranium and other metals.

The first part of the handbook contains a concise description of the various methods. The second describes the working details, which are recorded very fully for the benefit of chemists with little or no previous experience in this type of work. Analysts engaged in this field will have a selection of reliable methods to use, the choice depending on the nature of the material to be examined and laboratory facilities which are available.

The handbook was prepared at the request of the Division of Atomic Energy, U.K. Ministry of Supply. The methods described are those which have been found most satisfactory in practice at the Chemica Research Laboratory.

The Australian Journal of Science

Dates of Issue

Volume 12, 1949–50

No.	Month	Date Issued
1	August	15.12.49
2	October	18.4.50
3	December	24.5.50
4	February	20.7.50
5	April	12.9.50
6	June	12.10.50

Volume 13, 1950–51

No.	Month	Date Issued
1	August	11.12.50
2	October	10.1.51
3	December	6.2.51
4	February	13.4.51
5	April	23.5.51
6	June	4.7.51

Commencing with Volume 14, the Annual Subscription for the *Journal* will be Fifteen Shillings.

Date of issue.	Date of issue.	Date of issue.
11.9.55		
2.8.57		
18.3.58		
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13.12.61		